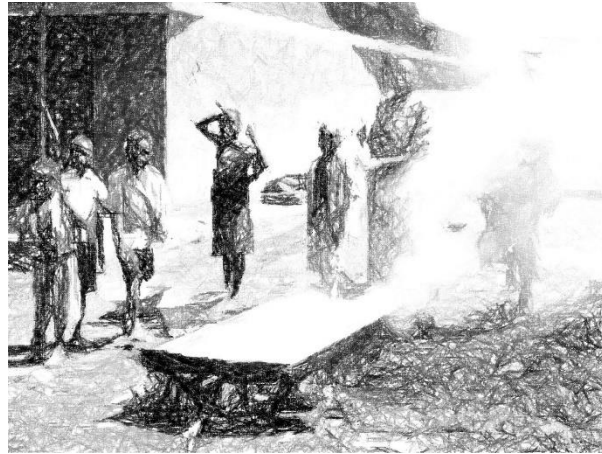# COMPARING PREVALENCE OF ALCOHOL USE AMONG CHILDREN AND ADOLESCENTS AGED 6 TO 13 YEARS IN RURAL VS URBAN AREAS:

A SYSTEMATIC REVIEW AND META ANALYSES

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Photo: Brewing mum and children, manipulated photo. Permission, IMS Engebretsen

THESIS FOR THE DEGREE:

MASTER OF PHILOSOPHY IN GLOBAL HEALTH

CENTRE FOR INTERNATIONAL HEALTH
DEPARTMENT OF GLOBAL PUBLIC HEALTH AND PRIMARY CARE
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Contents

EXECUTIVE SUMMARY

Background

Alcohol use has been observed among young age groups and reported in some studies. This problem has persisted despite laws directing a delayed initiation of alcohol use. Therefore, there is a need for further studies on various factors behind alcohol use among younger people. This systematic review will investigate urban and rural prevalence of use of alcohol among 6- to 13-year-old children and possible associated factors.

Objectives

To compare the prevalence of alcohol use between rural and urban 6- to 13-year-olds and where urban and rural prevalence are described, to identify potential other factors that are linked to the use of alcohol and affect the prevalence.

Inclusion criteria

Community populations of 6- to 13-year-olds reporting on alcohol use in rural or urban areas. Excluded are all non-community populations and any samples outside the age group of interest.

Search strategy

We searched these data bases: OVID (MEDLINE, EMBASE, PSYCinfo), WebOfScience and Cochrane Central. For this study, we excluded Proquest as it only contains non-peer reviewed theses. The search was conducted on January 9th, 2020, for a larger systematic review on the global prevalence of alcohol and substance use among 6- to 13-year-olds. For this study, we searched the subset of papers that had "rural", "urban" or "rural and urban" in the abstract.

Methodological quality

Quality appraisal was done using the Joanna Briggs Critical Appraisal Checklist. The checklist included 9 questions used to appraise the bias in each study.

Data extraction

Data was extracted into an excel spreadsheet. Various data elements were listed and extracted that would answer our specific objectives.

Data synthesis

The collected data was sub-grouped to keep similar studies together and were meta-analysed to show combined prevalence for the sub-grouped data.

Results

Among children who used alcohol in their lifetime, rural dwelling children had higher prevalence (29.5%, 95% CI -2.2 to 61.3) compared to urban dwelling children (17.4%, 95% CI 10.4 to 24.5). This was not the case with 10- to 11-year-old and 12- and 13-year-olds where both groups had higher prevalence of alcohol use among urban compared to rural dwelling children. For the 10- to 11-year-old children prevalence was 6.9% (95% CI 3.8 to 9.9) for rural children and 40.2 (95% CI 35.2 to 45.2) for urban children. For the 12- to 13-year-old, urban children's alcohol use prevalence was 18.2% (95% CI 13.5-23.0) for rural and 31.9% (95% CI 22.8-41.1) for urban dwelling children meaning that the urban dwelling children had higher prevalence of alcohol use compared to rural dwelling ones. These differences were

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all statistically significant (p<0.05). For the studies conducted in China, rural alcohol prevalence was at 8.6% (95% CI 7.1-10.1) and urban 38.4% (95% CI 35-41.8). In the studies conducted in the USA, there was not a large difference between urban and rural areas, the prevalence was 19.1% (95% CI 10.6-27.6) in rural areas whereas in urban areas it was 17.4% (95% CI 10.4-24.5). Funnel plots showed asymmetry in all the published papers which could be due to heterogeneity observed in the included studies, publication bias or chance. The included studies did not report factors affecting alcohol use according to location.

Conclusion

Alcohol drinking should be expected among children and young adolescents. This should be expected irrespective of location because as it is happening in both urban and rural areas. Also, this thesis found that alcohol was being consumed in all geographical areas of inclusion. The prevalence of alcohol consumption was higher in urban locations compared to rural locations for all the analysed subgroups except for USA and among lifetime alcohol users. For the USA, there was overlapping of confidence intervals between the rural and urban groups hence these findings may not be significant.

Implication for practice

There is a need for increased awareness within health systems and among practitioners related to the fact that children may be given or drink alcohol. Thus, there is a need to address whether children are being exposed to alcohol use at tender ages. Screening and assessment need to be improved.

Implication for research

This systematic review has shown that even though there are studies on young children's alcohol use, there are gaps that need further research especially among children aged less than 10 years. Even though data was excluded from this review due to its strict inclusion criteria, the absence of data of alcohol use in the age group of less than 10 years could point out to a need for further research into their drinking habits. Equally shown by this review is that there is need for more studies that will compare factors affecting alcohol use in relation to location. Studies designed to tease the link between alcohol use and location may point to obvious factors that may help in preventing and reducing alcohol use in different locations of residence.

Keywords (Alcohol use, children, adolescents, systematic review, substance use)

LIST OF ABBREVIATIONS

BC	Before Christ
CDC	Centers for Disease Control and Prevention
CI	Confidence Interval
DALY	Disability Adjusted Life Years
GDP	Gross Domestic Product
ICD 10	International Classification of Diseases 10
L	Litre
JBI	Joanna Briggs Institute
MMC	Majority Muslim Country
OR	Odds Ratio
OVID	Object View and Interaction Design
PhD	Doctor of Philosophy
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
UNODC	United Nations Office on Drugs and Crime
WHO	World Health Organization

ACKNOWLEDGEMENTS

BACKROUND

Alcohol is the most used substance globally, and this also applies to children and adolescents (1,2,3). McDermott et al 2013 showed that the frequency of alcohol use in children increased with increasing school grade showing that children tend to initiate alcohol as they progress through the school system (1). In the USA alone, studies show that alcohol intake in children starts early with 15% initiating alcohol use at 13 years of age (3). In the USA, national statistics show that 62% of 12th graders report to having used alcohol (4). The World Health Organization (WHO) Global Status Report on Alcohol and Health 2018 showed that 2.35 billion people aged 15 years and more consumed alcohol in 2016 (5). Even though the above studies paint a grim picture of alcohol use among children and adults, there is a general downward trend in alcohol consumption and binge drinking observed among 12th graders who reported using alcohol at least once in the USA (4). In this subpopulation in the USA, alcohol consumption and binge drinking declined by over 20 percentage points between 1997 and 2018 (4).

Alcohol initiation in children has been shown to be a harmful practice which sometimes is initiated by those who are supposed to protect the children. It has been observed that alcohol drinking initiation in children is done when they are as young as 5 years old or younger by a relative, parent/ guardian or friend (6 –12). The early initiation of alcohol use by children may have effects on these children in terms of their mental and physical health. Alcohol use in children, whose brains are still developing, has been shown to affect the hippocampus which develops until the age of 20 years leading to learning difficulties and memory problems (12). Additionally, early alcohol initiation has been observed to lead to greater alcohol use, problematic substance use in adulthood, poorer academic outcomes, greater mental health problems and more injuries, some of which may be fatal (2,7,8,13). This practice needs a specially designed intervention informed by relevant research.

The WHO has stated that alcohol and other substance use is a public health problem and have thereby put a target to reduce harmful use by 2030 (5). The SDG 3 target 5 "Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol" aims at combating substance use (5). Due to limited studies being done on early childhood and pre-adolescent alcohol use, there may be a risk of ignoring this age group in the reduction of harmful alcohol use as this group may not have the necessary interventions designed to curb the problem and thereby affect achievement of the target. This clearly points out to the need for more research in this subgroup. This paper, a systematic review of published papers reporting on alcohol use among 6- to 13-year-olds, will investigate differences in prevalence among rural and urban children, and try to tie these differences to social, economic, and cultural differences observed in these locations.

Alcohol use and the United Nations Agenda

The harmful use of alcohol was included in the priority areas that need to be addressed in the SDGs by the United Nations (UN) and an area for intervention. For alcohol use to be termed "harmful", the WHO recommends that the volume of alcohol taken, frequency and patterns of drinking and context of drinking that may lead to danger to others and self to be considered (14). The WHO included reduction of harmful alcohol use among its targets for 2030 SDG 3 target 5. The SDGs aim for an equitable future by 2030 and reducing harmful alcohol and other substance use will impact up to 14 other SDG targets (14). This means that once all countries manage to achieve this target, other 14 SDGs will be closer to being achieved. The World Health Organization Global Status Report on Alcohol and Health 2018 exhorts government leaders to be committed to reducing the current trends of harmful alcohol use and other

substance use through policies and frameworks designed to tackle this problem (5). Cooperation between country leaders and WHO recommendations have, in some European countries, already shown success as now the per capita alcohol consumption among 15 year old and above has decreased from 12.3 litres in 2005 to 9.8 litres in 2016 (5). This reduction in alcohol consumption has shown that with coordinated efforts between the UN and member countries, there may be progress towards reduction of harmful alcohol use.

Global alcohol use trends

Global substance use trends have showed a mixed picture with alcohol consumption among 15 year old and above decreasing in western European countries, but rising in Asia, especially India and China, with stable consumption rates in Africa and south America (14,15). The proportion of alcohol drinkers in Africa, East Mediterranean and Europe has been on the decline since 2000. However, Europe continues to have the highest per capita alcohol consumption of 9.8 liters(L) of pure alcohol per year in 2016 (5). A study has estimated that by 2030, the per capita alcohol consumption will rise to 7.2 L from 2017's 6.5L and the rates of abstinence from alcohol will decrease from current 43% to 40% (15). These data are of 15 years and older population globally. There are limited research publications on alcohol use in children and adolescents aged less than 13 years as compared to adolescents and adults (17). However, the limited papers available show that there is a decrease in substance use especially in Iceland and other European countries, the larger global trends show a mixed picture and may predict a rise in alcohol consumption in the future (15,18). As a result, the need for effective measures to reduce harmful alcohol and other substance use is warranted.

Burden of outcomes of alcohol use

Alcohol use is prevalent in the global population as shown in the WHO publication on Global Status Report on Alcohol and Health 2018. This report shows that in 2016, 2.3 billion people were current drinkers, the majority of whom live in the WHO regions of Europe, Americas and Western Pacific regions (5). The Global Disease Burden report of 1990 showed that alcohol use led to 0.3% of all Disability Adjusted Life Years (DALYs) (13) however, by 2019, it contributed to 1.6% of all DALYs (3). Alcohol is a contributing cause to more than 200 diseases and injuries in the International Classification of Diseases and Injuries (ICD) 10, of which 40 are directly linked to alcohol consumption (20). Besides alcohol being the most widely used substance among adolescents compared to other substances - cigarettes, marijuana, opioids and prescription substances (1,2, 20) - it is also the most widely available substance recognised as legal by any government and thereby easily available for use (6).

Alcohol use is linked to economic and health burdens in many countries. In the USA alone, 95,000 people die each year from effects of alcohol use with 7% of drinking adults suffering from Alcohol Use Disorder (AUD) (4). Advanced liver cirrhosis, which is associated with alcohol consumption, contributed to 19.1% of all alcohol related deaths in the USA (4). The economic costs attributed to alcohol use has been estimated to be at 2.6% of the Gross Domestic Product (GDP) of which about 40% are direct costs and the majority (60%) are due to lost productivity (21). Fetal alcohol syndrome affects 3.74/100 000 of the population in the WHO European Region and 25.2% of women consume alcohol during pregnancy (14). The report on Alcohol Consumption and Sustainable Development by WHO 2020 further reports that in the WHO Europe Region, 1 in 4 deaths of youths aged 20 to 24 years is directly caused by alcohol with 10.1% of deaths indirectly as a result of alcohol (14). Alcohol use has deleterious effects on the

economy of a country as well as individuals. Therefore, efforts in curbing harmful alcohol use are necessary for the economy and individual health of people.

Rural and urban substance use

Alcohol use is not the norm among children and so alcohol use among 6- to 13-year-old children in rural and urban areas may be affected by different socioeconomic and demographic factors. The question of whether alcohol is mostly used in urban or rural settings has been studied by various researchers however, substance use has shown mixed results in different countries when it is compared among urban and rural populations (22).

Rural and urban areas have distinct social factors, as well as differences in infrastructure and culture. In rural areas in the USA and Canada, rural adolescents face geographical isolation, structural disadvantages in terms of socioeconomic disparities, limited recreational activities and reduced access to healthcare services (10,23).

Traditional brews have been produced and drunk in various rural areas around the world for many years. In these areas, mainly women brewed alcohol for festival and ritual ceremonies but also as an income generating activity. Hans Onya et al (2006) reported that the use of alcohol in colonial South Africa became a symbol of defiance where homes acted as brewing sites with illegal liquor stores thriving and becoming a cultural phenomenon (6). In rural South Africa, traditional brews are readily available and socially acceptable to drink even by children, and some are being given alcohol by caregivers as babies and up to 5 years of age. Those of school going ages drink together with their teachers at clubs during out of school hours rendering the control of alcohol use ineffective (6). This has been associated with rural areas norms about alcohol use in youth where it is believed to be more socially acceptable and less control measures available to control under-age drinking (6,13). However, within country variations have been observed. While Onya et al observed that rural, black schoolchildren in South Africa had a prevalence of alcohol intake as high as 22.2%, Madu et al 2003 observed a prevalence estimate of 39.1% in their study on urban, semi-urban and rural populations of all races from South Africa (6,24). This could mean that these observable differences between rural and urban areas do have an impact on alcohol use and therefore targeted interventions should be designed having in mind these differences.

Some authors have looked at social risk and protective factors in settings that may be associated with alcohol accessibility and hence alcohol use. As we have seen, Onya et al researched home brewed alcohol use among adolescents in a rural area in South Africa. They discovered that adolescents can freely access alcohol because of availability of home brewed alcohol and plentiful liquor stores, festivities, rituals and lack of control by schools and the community (6). While this has been observed in South African rural communities, different findings have been reported in in Nigeria. Ogunoola et al in 2017 studied risk and protective factors for adolescents' substance use among urban and rural areas in Nigeria. They observed that prevalence of alcohol use was similar in urban and rural areas however, the findings were not statistically significant (11). Risk factors observed in rural and urban areas were different depending on location even though prevalence of alcohol use was similar (11). Parental norms on substance use were a significant risk factor in urban areas while in rural areas, school type (private school), fathers' and mothers' education (at tertiary level), and low level of parental connectedness were statistically significant risk factors. Approval of substance use and friends who use substances were

significant in both rural and urban areas (11). These studies further underline the potential impact of rural and urban settings in risk and protective factors affecting alcohol use among adolescents.

Other identifiable social factors in rural and urban areas that may affect alcohol and other substance use among adolescents could lie in the culture of the region. In African settings, there are observed stronger social ties and traditional use of substances like cola nuts, khat, local brews common in rural settings and these may play a part in prevalence of substance use as seen in West African countries (25). In contrast, urban areas have more affluent populations and less strong family ties with more nuclear families. Alcohol and substance use is mainly observed in families where a parent uses alcohol or substances and may result in the child also using the same substances (6,8,11,26). Rural and urban settings therefore may have identifiable factors that could dictate and guide design of interventions for alcohol use reduction.

Injuries related to alcohol use in relation to rural and urban settings have been studied in Canada (13). Jiang et al, 2008 studied alcohol use across rural-urban gradient and concomitant injuries (13). The authors examined 11- to 15-year-olds across 5 groups of rural to urban location gradients concerning risk patterns. In their findings, they noted that as these adolescents engaged in alcohol use, their risk of injuries increased regardless of geographical location. They also observed variations in alcohol use with rural areas being consistently higher. All these led to risk taking behaviour which included driving under the influence of alcohol (13). Rural youth in North America have been observed to be initiating earlier and consuming more alcohol compared to their urban counterparts (13). In summary, rural Canadian adolescents consumed alcohol at higher rates than their urban counterparts. They observed that there are higher rates of injuries resulting from alcohol use in rural samples and higher injuries with higher alcohol use (13). They proposed that the higher rates of alcohol use among the rural sample could be because of norms in rural areas of risk taking and social norms in alcohol use. In this study, alcohol use was directly related to higher occurrence of injuries among adolescents regardless of location.

Other authors have looked at substance use in a particular race across different geographical locations within the USA. Kogan et al, 2006 compared substance use among African American youths living in urban, suburban and rural areas in Southern USA (23). They discovered that rural youths used all the 16 substances under investigation including alcohol compared to urban and suburban youths who used some but not all the substances under study. This study showed that African American rural youth reported equal to or more substance use compared to urban and suburban youths.

Alcohol use and its impact on children

Alcohol exposure has been shown to have detrimental effects on children's development. Alcohol has been proved to affect the fetus in utero if a pregnant woman takes alcohol resulting in the Fetal Alcohol Spectrum Disorders which include Fetal Alcohol Syndrome and other conditions like partial fetal alcohol disorder and alcohol-related neurodevelopmental disorder (5). Alcohol may also cause birth defects. For children who are younger than 21 years, alcohol has been shown to affect the hippocampus neurons resulting in memory and learning difficulties (27). Alcohol is toxic to the hippocampus and has been shown to affect the neurobiological and neurobehavior of children (27).

Regardless of scientific recommendations to delay alcohol initiation, different studies have shown that adolescents as young as 12 years have begun binge drinking alcohol (28). Furthermore, studies show that children who initiate substance use before age of 21 are more likely to be long term users in their adulthood (29). Additionally, an early start at drinking alcohol has been associated with chronic use in

adulthood (30). The majority of South African youth starts alcohol at an average age of 15.7 years (6) using traditional brews whereas in the USA it was 11.7 years (7). Moreover, early alcohol initiation has been observed across different studies which show that alcohol use starts at young ages and much earlier among whites or descendants from European Americans compared to descendants from African Americans (32- 34). This points to a need for interventions to prevent children from early initiation of alcohol with local adaptations and risk factors in mind.

Due to the magnitude of burden alcohol use has on healthcare and economy, early initiation and use in children requests for more robust interventions that will address alcohol use among children and adolescents if we are to decrease prevalence of adults addicted to substance use. Additionally, the brains of adolescents are biologically prone to worse outcomes if exposed to different substance use hence further increasing the burden on healthcare and other related services like academics and justice system (7,28,35,36). All these adverse outcomes of alcohol use point to a need for interventions that will be based on a broad understanding of the dynamics involved in alcohol use in children.

History of alcohol and social norms around alcohol use

Alcoholic drinks have been in existence for millennia. The earliest evidence of alcoholic drinks was found in Haifa in Israel and it is dated to be 13000 years old (35). It is believed that this alcohol was used in ceremonies to honor the dead and was brewed from cereals. Archaeological evidence in China has shown the existence of alcohol as far back as 7000 Before Crist (BC), Egypt in 3150 BC and Sudan in 1500 BC (43, 40). Across the years, wine and other alcoholic brews were not only used in ceremonies but also in medicines and as part of their diets. The ancient Hebrews used alcohol in medicine as seen in the Bible, book of Proverbs and II Timothy. It is evident that alcohol production has a bearing in social norms around alcohol consumption and acceptance.

Ethanol production is an industry with beneficial effects. Alcohol is an organic chemical compound containing the hydroxyl group (-OH). In chemistry, there are many different types of alcohols but in this study, we will focus on the commonly consumed ethanol. Alcohol is readily available in many forms, ranging from beer to hard liquors like whiskey and rum, due to its simple methods of production. It is possible to brew alcohol from everyday ingredients and using very crude and rudimentary technology. Approximately 25.5% of alcoholic beverages consumed are not labeled with the amount of alcohol content since they are produced in non-official factories (5) and this industry has been thriving especially in rural areas. As a result, alcohol is ubiquitous and accessible compared to other substances of abuse and a ready source of money to producers at different levels of production. Alcohol can be obtained cheaply if it is locally brewed since there are no government taxes paid nor expensive industry investments involved. With minimal investment, any individual can start production and earn money. The use of modern metal drums for brewing was observed to increase volume of alcohol produced by local means by women in South Africa and this led to even more alcohol available cheaply for the blacks circumventing income from the government (6). Despite alcohol being commonly used as a beverage, it is used in vehicles mixed with petrol as ethanol and Brazil has passed a law allowing to mix petrol with ethanol since 2007 (38). Use of ethanol in petrol vehicles is also considered beneficial to the environment.

Early initiation of alcohol use was observed in Peru by Ramirez-Ubillus et al in 2018 who reported that mothers considered traditional brews to be nutritious and give to their children some as young as 5 years old (26). The alcohol content in home brew is usually not known, and this poses a risk for the children using these alcoholic beverages. These mothers did not perceive alcohol use in their children as harmful. They reported that they were also given alcoholic drinks as children and believed that it made them stronger. They believed the alcoholic drinks to be nutritious and healthy. All this paints a picture of a relationship between alcohol brewing history and socially accepted norms around alcohol use.

In North Africa and the Middle East, the countries are mainly Muslim Majority Countries (MMC), alcohol consumption is strictly controlled due to religious beliefs where the Quran prohibits alcohol use by its followers. In these countries, especially those in the Arab Gulf, alcohol use is forbidden by law from drinking in public but there are also strict measures in its production and distribution. As a result, there is very little literature on alcohol use available and especially for alcohol use in children and adolescents (39). However, alcohol use is a problem even though prevalence of alcohol use is lower relative to other countries (39,40). Turkey is a MMC that is highly permissive of alcohol and, on the other hand, Saudi Arabia is a highly restrictive and prohibitive of alcohol use and both have very different dynamics of alcohol use despite both being MMC (40). This could mean that being in a country where alcohol is seen as partially illegal may not be a control measure against alcohol use. It could also show that social norms have a complex relationship with alcohol use in a society.

Rationale

The age group of 6- to 13-years was chosen because it is an age which in most countries, coincides with primary education. Additionally, there is a paucity of studies which focus on 6- to 13-year-olds using alcohol, and there are inconsistent results related to the effect of urban vs rural residence. The importance of describing prevalence pattern differences among urban and rural populations among 6- to 13-year-olds serves dual purposes. Firstly, it will portray a better picture of the social dynamics of substance use in relation to urban vs rural habitation. Secondly, once these differences in prevalence are reflected, better suited public health interventions can be designed that will better work in curbing the problem. This systematic review aims to contribute to the knowledge base of alcohol use among children and young adolescents in urban and rural areas. Therefore, this paper sets out to compare prevalence of alcohol use in 6- to 13-year-olds living in rural and urban areas and will investigate the attributable factors based on location, and link these to the observed differences in alcohol use.

OBJECTIVES
   a) To compare the prevalence of alcohol use between rural and urban 6- to 13-year-olds
   b) Where urban and rural alcohol prevalence are described, to identify other factors that are linked to the use of alcohol and affect the prevalence.

Methods of the Review

Eligibility criteria
Inclusion criteria and exclusion criteria

Table 1: Inclusion and exclusion criteria for this study

A) Inclusion criteria	
Population, participants, and conditions of interest	Community populations of 6- to 13-year-olds.
Interventions or exposures	Alcohol use
Comparisons or control groups	Rural vs urban
Outcomes of interest	Alcohol use among 6- to 13-year-olds in urban vs rural populations
Setting	Community sample of: Rural Urban Rural and urban
Study designs	Cross sectional studies published after year 2000.
B) Exclusion criteria	
Excluded studies with populations that are sampled for a vulnerability/protective factor and 100% of the population shares this factor, such as studies on street children or foster children. Excluded are non-peer reviewed, non-English papers, outside age range of interest, qualitative papers, vulnerable populations and/ or any other non-community samples. All papers published before 2000 were excluded	

Information Sources

We searched the following data bases: OVID (MEDLINE, EMBASE, PSYCinfo), WebOfScience and Cochrane Central. For this study, we excluded Proquest as it only contains non-peer reviewed theses. The search was conducted on January 9th, 2020, for a larger systematic review by Dr V. Skylstad (VS) on the global prevalence of alcohol and substance use among 6- to 13-year-olds (41).

Deviations from the protocol of the larger study

The protocol for the original study was published on PROSPERO (CRD42020155167) (41).

Due to limitation in time and resources for this master thesis, we made some pragmatic deviations from the protocol:

- We only included articles of English language
- We excluded studies that did not report disaggregated data for our specified age group (e.g., if they reported on children aged 12-17, but did not report the data for the age group 12-13 specifically)

- We did not ask authors for original data when data for our age group was not reported
- We did not complete a hand searching the reference lists, reviews, or book chapters
- We did not do an updated search after the selection of articles was completed
- We excluded non-peer reviewed masters and PhD theses (ProQuest database)
- We excluded studies with only school grade, and not age indication, as the age in different grades varies greatly across the world.

Search strategy

For the original dataset, a librarian contributed to developing the search for each database. The full search strategy for the different databases are included in appendix 1 and a summary of search terms is shown below.

The search was conducted using the combinations of terms displayed in Table 2: terms used for search.

Table 2: Terms used for the search

Population	Exposure	Outcome
	AND	AND
child*.ti,ab,kw. (young or youth or school).ti,kw,ab. adolesc*.ti,kw,ab.	"substance use".ti,kw,ab. (alcohol adj4 (misuse or intake or "use" or drink*)).ti,kw,ab. Substance-Related Disorders/ drinking behavior/ or "marijuana use"/	(prevalence or occurrence or proportion or epidemiolog* or cross-sectional or "cross-sectional" or survey or cohort).ti,ab,kw.

Selection Process

A search for this master thesis was conducted within the search for the larger systematic review by VS (n= 9970 after deduplication and initial screening of irrelevant titles). This was done by making a subset of articles that contained the words "urban" and "rural" in the title and abstract, generating 926 papers for review.

AJN and VS screened these papers independently using the Rayyan software (42), and checking full texts, when necessary. Conflicts and disagreements were resolved by discussion. This led to identification of 38 candidate papers of which 15 were included after discussions between AJN and VS.

For this thesis, the research papers included were specifically those reporting on alcohol use among children aged 6 to 13 years, or a subset of that are range. Papers with age ranges beyond the desired age range were included only if they had disaggregated the prevalence data by ages. Any paper that did not disaggregate ages or used grade instead of years of birth were excluded because of time restrictions limiting the possibility to inquire for raw data from the authors.

Study Selection

Figure 1: A PRISMA flow chart showing the selection process (43)*.*

Identification of studies via databases and registers

Identification

Records identified from:
Larger study (n = 9970)

→

Records removed *before screening*:
Records excluded after search in Rayyan with the words "urban", "rural" and "urban and rural" in the titles and abstracts (n = 9,044)

Screening

Records screened
(n = 926)

→

Records excluded by VS and AJN
(n = 888)

Reports sought for retrieval
(n = 38)

→

Reports not retrieved
(n = 0)

Reports assessed for eligibility
(n = 38)

→

Reports excluded:
Age not disclosed (n = 3)
Includes children over 13 years (n = 6)
Includes children aged less than 6 years (n = 1)
Reports on substance use other than alcohol (n = 5)
Parental alcohol use and not child (n= 2)
Thesis (n= 5)
Missing information for analysis (n=1)

Included

Studies included in review
(n =15)

Data Collection Process

Data was collected using the Joanna Briggs Institute (JBI) Extraction Form for Prevalence and Incidence Studies (44). AJN extracted data from the selected papers.

Data Items

The following data items were extracted into an excel spreadsheet:

- Title of paper
- Authors
- Year of publication
- Journal
- Aim of the study
- Study Method
- Setting
- Country
- Design
- Sample size
- Subjects' characteristics (age, gender)
- Exposure (substance investigated, timeframe of report, frequency, tools of measurement)
- Associated factors social e.g., peer use, parental use, religiosity, truancy,
  - Biological e.g., gender,
  - Geographical e.g., country, rural vs urban use,
  - Economic e.g., poverty levels, household income, for students if they receive food stamps or food at school,
  - (Parental use, peer use, trauma, exposure, tools of measurement)
- Odds Ratio (OR) and Risk Ratio/Relative Risk (RR) with confidence intervals (CI)
- Prevalence
- Ethical Approval
- Comments from the author
- Comments from the reviewer
- Possible bias

Study risk of bias assessment, Methodological Quality and Certainty Assessment

The biases of the individual studies reviewed using the JBI Critical Appraisal Checklist are reported in table 3. A funnel plot was drawn to assess publication bias where standard errors were plotted against effect size which was the prevalence. Certainty assessment for this systematic review was done using the JBI Critical Appraisal Checklist as shown in table 3 (44). Grading Recommendations Assessment Development and Evaluation (GRADE) was not used to assess certainty (or confidence) in the body of evidence for prevalence.

Quality appraisal was done using the JBI Critical Appraisal Checklist. The checklist included 9 questions used to appraise the bias in each study. The findings are shown below.

Table 3 showing the quality appraisal according to Joanna Briggs Institute

Study	Q1: Was the sample representative of the target population?	Q2: Were study participants recruited in an appropriate way?	Q3: Was the sample size adequate?	Q4: Were the subjects and settings described in detail?	Q5: Is the data analysis conducted with sufficient coverage of the identified sample?	Q6: Were objective, standard criteria used for measurement of condition?	Q7: Was the condition measured reliably?	Q8: Was there appropriate statistical analysis?	Q9: Are all important confounding factors/ subgroups/ differences identified and accounted for?	Q10: Were subpopulations identified using objective criteria?
Brunborg, et al 2019	Y	Y	Y	Y	Y	Y	N	N	N	UN
Hemphill, et al 2007	N	N	N	Y	Y	N	N	Y	Y	Y
Jaisoory, et al 2016	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ricardo, et al 2019	Y	Y	Y	N	Y	Y	Y	Y	N	N
Dickens, et al 2016	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Jiang, et al 2015	Y	UN	N	N	Y	Y	Y	Y	Y	Y

Study	1	2	3	4	5	6	7	8	9	10
Lemstra, et al 2012	Y	UN	Y	Y	Y	Y	Y	Y	Y	Y
Okamoto, et al 2014	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Byck, et al 2013	Y	UN	Y	Y	Y	Y	Y	Y	Y	Y
Cance, et al 2013	Y	Y	Y	N	Y	Y	N	Y	Y	Y
Lee 2012	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Beal, et al 2001	N	Y	N	N	Y	Y	Y	N	Y	Y
Hipwell, et al 2010	Y	UN	Y	Y	Y	Y	Y	Y	Y	Y
O'Donnell, et al 2010	Y	Y	N	Y	Y	N	N	Y	N	Y
Jiang, et al 2005	Y	UN	Y	Y	Y	Y	Y	Y	N	Y

Prevalence Measures

The effect measure in this systematic review was the prevalence of alcohol use in our age group of interest according to location. The confidence interval was 95%.

Synthesis Methods

The aim of synthesis of this data was to obtain the difference in prevalence of alcohol use among children aged 6-13 years and compare this between urban and rural settings. Prevalence data of alcohol use was extracted from all the 15 included studies. In addition to the prevalence, the 95% confidence intervals, standard deviation and standard error of the mean were also extracted. These data were used in getting the combined effect size for rural and urban populations.

In the identified 15 studies, it was possible to calculate the standard error, standard deviation, and confidence intervals. Even though Foster et al 2018 reported prevalence of alcohol use among 12 and 13 year old children, the study was dropped from the analysis because they did not report the number of participants in those age groups, standard errors nor standard deviations (32). It was not possible to calculate standard error, standard deviation nor the confidence intervals for the prevalence in the Foster et al 2018 paper due to missing number of participants for those age groups. Therefore, this systematic review will exclude this paper from the synthesis.

There were variations between the studies in what prevalence estimates they reported. These varied by ages, frequency of drinking, intervention groups and race in some instances. Some studies reported prevalence for each age group they studied for example, Cance et al 2013 reported prevalence estimates for each age in years from 11 years to 13.5 years, i.e., age intervals of 0.5 years from age 11 years up to 13.5 years (45). Jiang et al 2005 reported prevalence of alcohol use for 11-year-old (40.4%) and 13-year-old (36.8%) children separately (46). Byck et al 2013 reported prevalence of alcohol abuse (0%) and alcohol dependence (0%) among 13 year old (47). O'Donnell et al 2010 looked at intervention and control groups for parents on how to better talk to their children to delay initiation of alcohol use and sexual behavior (48). This paper reported baseline prevalence of alcohol uses specifically that 14.6% ever had alcohol, 5.6% took alcohol more than once and 3.4% got drunk (48). Okamoto et al 2014 reported prevalence of alcohol use for Hawaiian (63%) and non-Hawaiian (20%) (49). These variations led to obtaining more prevalence values for the analysis howbeit with great heterogeneity.

The studies included in the systematic review reported either urban alcohol use only, rural alcohol use only and Brunborg et al 2019, Jaisoorya et al 2016 and Hemphill et al 2007 reported pooled alcohol use data (50–52). This resulted in the synthesis of the information separately according to location. This however showed heterogeneity of the data and so subgroup analysis was done to try and analyse more homogenous data. The subgroups were by age category, frequency of alcohol use and continent where the study was conducted. These age subgroups included, for age categories: 10 to 11 years and 12 to 13 years. No studies included children aged younger than 10 years. Further subgroup by continent (3 continents namely North America, Europe and Asia) and by frequency of alcohol use (lifetime user, past 30 days use and binge drinking), were analysed and disaggregated by rural vs urban location. However, for continent category, Europe only had one study (50) so this was not included in the meta-analysis. For the category on frequency of alcohol use, only one study reported binge drinking (53) and past 30 day use of alcohol (50) so only lifetime alcohol use was included in the meta-analysis.

Forest plots were drawn which showed each prevalence data obtained from each subgroup and a combined prevalence was obtained for the subgroup.

RESULTS

The studies selected for this systematic review were published between 2001- 2019 and focused on alcohol use among 6- to 13-year-old children. The systematic review looked at papers that reported rural or urban or both rural and urban in the title or abstract. A total of 15 studies were included. Among these, 7 reported on urban samples only, 5 reported on rural samples only and 3 reported pooled prevalence for both urban and rural samples. Eight studies were conducted in the United States of America, two were in China and the remainder were one each from Australia, Brazil, Canada, India and Norway. None of the studies were from Africa, South America or the Middle East.

The information obtained from the included studies was not uniform across the papers. From these 15 studies included, the ages of interest reported ranged from 10 years to 13.5 years. From this search, we could not find data of alcohol consumption in children aged less than 10 years. Some studies reported age ranges beyond the set age of interest e.g. Brunborg et al 2019, Cance et al 2013, Dickens et al, 2016 to mention a few (45,50,54). Frequency of alcohol use was also reported differently in each paper. Some authors reported alcohol use as a lifetime practice while others reported one-time alcohol use. Some reported alcohol abuse and others alcohol dependence e.g. Byck et al 2013 (47). In some cases, the study reported both lifetime alcohol use and use in the past 30 days e.g. Brunborg et al 2019 (50). Since prevalence variables were not homogenous, they were subgrouped before analyses. The table 4 shows the 15 studies and participants included in the review eligible for data extraction and analysis, and summarizes some of the key data obtained from the studies included in the review.

Table 4 showing the included studies

S No	Title of paper	Authors	Year of publication	Journal	Setting	Country	Sample size	Prevalence
1	Monitoring young lifestyles (MyLife) - a prospective longitudinal quantitative and qualitative study of youth development and substance use in Norway	Geir Scott Brunborg, et al	2019	BMJ Open	Rural and urban	Norway	1141 aged 13 years (SD 0.09)	Ever consumed alcohol 9.3% Past 30 days' alcohol use was 2.3%
2	Prevalence of mental health disorders among low-income African American adolescents	Gayle R. Byck, et al	2013	Soc Psychiatry Psychiatr Epidemiol (Springer)	Urban	USA	10 aged 13 years old	Alcohol abuse 0% Alcohol dependence 0%
3	Perceived pubertal timing and recent substance use among adolescents: a longitudinal perspective	Jessica Duncan Cance, et al	2013	Society for the Study of Addiction	Urban	USA	11,390 aged between 11 years and 13.5 years	11 years 3.1%, 11.5 years 8.1%, 12 years 8.8%, 12.5 years 13.8%, 13 years 16.6% 13.5 years 20.5%
4	Alcohol consumption among rural African American and White adolescents: The role of religion, parents, and peers	Danielle D. Dickens, et al	2016	Journal of ethnicity in Substance Abuse	Rural	USA	9,691 aged 12 to 14 years old	23% (SD 0.42) for African Americans aged 13 years 28% (0.45) for White Americans aged 13 years
5	Adolescents' Expenditure on Alcohol: A Pilot Study	Sheryl A. Hemphill, et al	2007	Australian Journal of Social Issues	Rural and urban	Australia	7 aged 13 years old	5% among 13-year-old

6	Prevalence and correlates of alcohol use among adolescents attending school in Kerala, India	T. S. Jaisoory, et al	2016	Drug and Alcohol Review	Rural and urban	India	173 aged 12 to 13 years	12–13 years: Males 14.9%, Females 5.2 Pooled 9.9%
7	Alcohol consumption is higher among left-behind Chinese children whose parents leave rural areas to work	Shan Jiang, et al	2015	Acta Paediatrica Nurturing the Child	Rural	China	586 aged 12.3 (SD 1.27) years old	7.8% for those living with their parents and 8.6% for those who were left behind
8	Community violence exposure and adolescent substance use: does monitoring and positive parenting moderate risk in urban communities?	Rosalyn Lee	2012	Journal of Community Psychology	Urban	USA	716 aged 13 years or less	Alcohol use 24.53% Binge drinking 6.80% for those aged 13 years or less
9	Prevalence and risk indicators of alcohol abuse and marijuana use among on-reserve First Nations youth	Mark Lemstra et al	2012	Paediatric Child Health	Rural	Canada	271 aged 10 to 16 years old	10 years old 9.5% 11–12 years old 16.9%
10	Social influences on health-risk behaviors among minority middle school students	Anne C. Beal, et al	2001	Journal of Adolescent Health	Urban	USA	Total 208. 90 were 12 years, 100 were 13 years old 18 were aged above 13 years	37.50% among 12-year-old

11	Early predictors of sexually intimate behaviors in an urban sample of young girls	Alison E. Hipwell, et al	2010	American Psychological Association	Urban	USA	1,116 were 11 years old	Pooled 10.7% European Americans 15.7% African Americans 7.4%
12	Especially for daughters: parent education to address alcohol and sex-related risk taking among urban young adolescent girls	Lydia O'Donnell, et al	2010	Health promotion Practice	Urban	USA	268 girls aged 11 to 13 years and 258 parents	14.60% among 11- to 13-year-old children
13	The Social Contexts of Drug Offers and Their Relationship to Drug Use of Rural Hawaiian Youth	Scott K. Okamoto, et al	2014	Journal of Child and Adolescent Substance Abuse	Rural	USA	249 aged 11.9 years (SD 0.85) for Hawaiian youths and 11.69 years (SD 0.88)	63% for native Hawaiian youths 20% for non-native Hawaiian youths
14	Co-occurrence and clustering of the four major non-communicable disease risk factors in Brazilian adolescents: Analysis of a national school-based survey	Camila Zancheta Ricardo, et al	2019	Plos One	Rural and urban	Brazil	101,607 ages 13 to 16 years	16.3% among those aged 13 years old
15	Self-assessed dental health, oral health practices, and general health behaviours in Chinese urban adolescents	Han Jiang, et al	2005	Acta Odontologica Scandinavica	Urban	China	2662 aged 11, 13 and 15 1850 were 11 and 13 years	11-year-olds 40.2% 13-year-old 36.8%

Alcohol use according to location

Pooled Prevalence for both urban and rural populations

The studies that were conducted on both rural and urban populations showed pooled prevalence and therefore individual prevalence by urban or rural settings was not available (50–52,55). Differences in prevalence could not be determined according to rural urban settings however, Hemphill reported that rural drinkers were proportionately more than urban drinkers however, the difference was not statistically significant (52). Jaisoorya et al, 2016 reported that living in a town or city increased odds of being an alcohol user compared to living in the villages [OR, 95% CI 1.4 (1.1 to 1.7) for cities and 1.1 (0.8 to 1.3) for towns, respectively] (51).

The reported prevalence for each study in this group did not show confidence intervals nor standard deviations except Ricardo et al, 2019. These further limits statistical analyses that may be done for this group of studies.

Table 5 showing studies conducted in both rural and urban areas showing sample size and pooled prevalence

Authors	Year of publication	Sample size	Prevalence
Hemphill, et al	2007	187 aged 13 and 17 years 11 were aged 13 years old	13 years old was 5.0%
Jaisoory, et al	2016	7350 aged 12 to 19 years 1747 were aged 12 to 13 years old	12- to 13-year-old was 9.9%
Brunborg, et al	2019	3512 8th, 9th and 10th graders 1141 were aged 13 years old	13-year-olds who ever used alcohol were 9.3% 13-year-olds who used alcohol in the past 30 days were 2.3%
Ricardo, et al	2019	101607 ages 13 to 16 years 13-year-old population not known	13-year-olds were 16.3%

Rural Prevalence

Four studies included rural populations only (49,54,56,57). These studies reported prevalence and the Standard Deviation (SD) was reported for the Okamoto et al 2014 study (49). The other 4 studies only reported the prevalence without any standard deviations or confidence intervals. Most studies looked at prevalence for age ranges beyond the target age range, but the data were disaggregated allowing for the inclusion of the reported prevalence into the analysis. Table 6 below contains the studies conducted in rural areas.

In these studies, there were factors in the rural settings reported to be behind the alcohol use observed in our age group of interest, however, these factors were not reported to be unique to the rural environment. There were no comparisons in terms of effect of these factors on alcohol use between urban and rural; they were simply stated for rural areas. It was not possible to identify factors in the rural areas that were uniquely associated with the alcohol use by virtue of location. These studies,

therefore, could not answer our second objective of factors in the settings that may have led to alcohol use in this age group.

Table 6 showing studies conducted in rural areas, sample size, prevalence and effect measures

Authors	Year of publication	Sample size	Prevalence
Lemstra, et al	2012	204 aged 10- to 16-years 22 were 10-years old 98 were 11- to 12-years-old 82 were 13-years and above	10 years old 9.5% and 11–12 years old 16.9%
Okamoto, et al	2014	249 average age 11.9 years (SD 0.9) Hawaiian and 11.7 years (0.9).	63% (SD 1.1) for native Hawaiians 20% (SD 0.6) for non-native Hawaiians
Jiang, et al	2015	1367 10-14 years among whom 586 were living with their parents Mean age 12.3 years (SD 1.3) years)	7.8% among 10- to 12-year-old who stayed with their parents 8.6% among 10- to 12-year-old whose parents left
Dickens, et al	2018	23,163 ages 12 to 18 years 12- to 13-year-old children number not given	42% African Americans and 45% white Americans Prevalence given was for 13-year-old

Urban

The review included 7 studies that reported prevalence among the age of interest in urban settings (31,32,46–48,53,58). Among these studies, the O'Donnell et al 2010 was an interventional field trial to compare effectiveness of an intervention on Latino and black female participants on their alcohol use (48). The rest of the studies looked at alcohol use in the community only.

Table 7 showing studies conducted in urban areas showing sample size and prevalence

Authors	Year of publication	Sample size	Prevalence
Beal, et al	2001	208 90 were 12 years old 100 were 13 years old 18 were aged above 13 years	37.50% 12-year-old (p<0.001) Ages above this were aggregated
Jiang, et al	2005	2662 adolescents aged 11, 13 and 15 years 948 aged 11 years 902 aged 13 years	40.2% among 11-year-olds 36.8% among 13-year-olds
Hipwell, et al	2010	1,116 11 years (11.58 years SD 0.35)	10.7% among all races 15.7% among European Americans 7.4% among African Americans

| O'Donnell, et al | 2010 | 268 girls aged 11 to 13 years and 258 parents | 18.1% after one year of intervention 26.0% of control vs 14.0% of intervention |
| Byck, et al | 2013 | 592 aged 13 to 18 years of whom 10 were 13 years old | 0% |
| Lee | 2012 | 2197 717 were aged 13 years and below | 6.80% for binge drinking 24.53% for any alcohol or drug use |

Subgroup analysis

Due to the high heterogeneity in the studies, a subgroup analysis was done to reduce heterogeneity. The subgroups were according to frequency of alcohol use, continent and age groups 10 to 11 years and 12 to 13 years. These data were meta-analysed and a forest plot and scatter plot were drawn.

Lifetime alcohol use by location

The forest plot below is showing studies that reported lifetime alcohol use prevalence among our age group of interest. Studies that reported on lifetime alcohol use were 6 (31,48,49,53,56,59) and these were meta-analysed for urban and rural combined prevalence. The figure below shows a forest plot of these studies. The weights for all the 6 studies were reported and showed relative similar weight for all the studies. From looking at the plot, the studies show poor overlap of confidence intervals, and this points to heterogeneity. According to The Cochrane Handbook for Systematic Reviews of Interventions (60), studies in a systematic review and meta-analysis will be heterogenous. Moreover, studies had high I^2 showing that they were considerably heterogeneous. The pooled prevalence was 21.3% (95% CI 11.3 to 31.3) for this subgroup.

Figure 2 showing a forest plot of lifetime alcohol use among our age group by rural and urban location
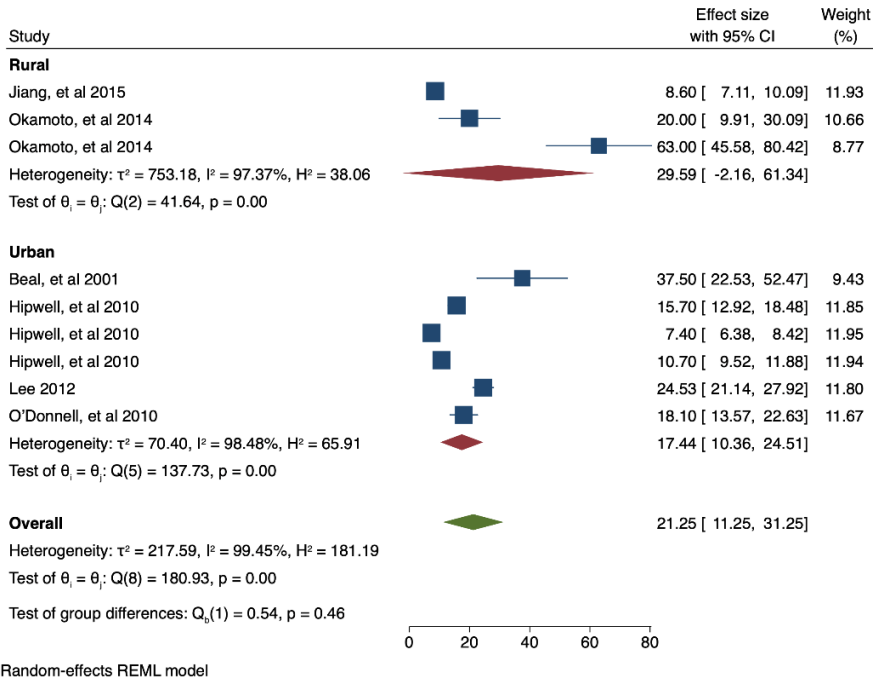
For the rural based population, prevalence across all the studies was 29.6% (95% CI -2.2 to 61.3). A total of 2 studies were meta-analysed and according to The Cochrane Handbook for Systematic Reviews of Interventions (60), this is the minimum number of studies that can be meta-analysed. When the prevalence has very wide confidence intervals the sample size used were not large enough to give any precise prevalence estimate.

A total of four studies were meta-analysed for the urban prevalence (31,48,53,59). The overall prevalence of alcohol use was at 17.4% (95% CI 10.4 to 24.5). The confidence intervals were less spread out showing that the sample sizes were large enough to show a more precise prevalence value.

In comparison, rural prevalence of alcohol use was higher than urban in this subgroup.

Alcohol use by age: 10 to 11 years

A subgroup of 10- to 11-year-old was formed and the reported prevalence of alcohol use among 10- to 11-year-old children was analysed in a forest plot.

Figure 3 showing a forest plot of studies reporting on prevalence of alcohol use among 10- and 11-year-old children according to rural and urban location.
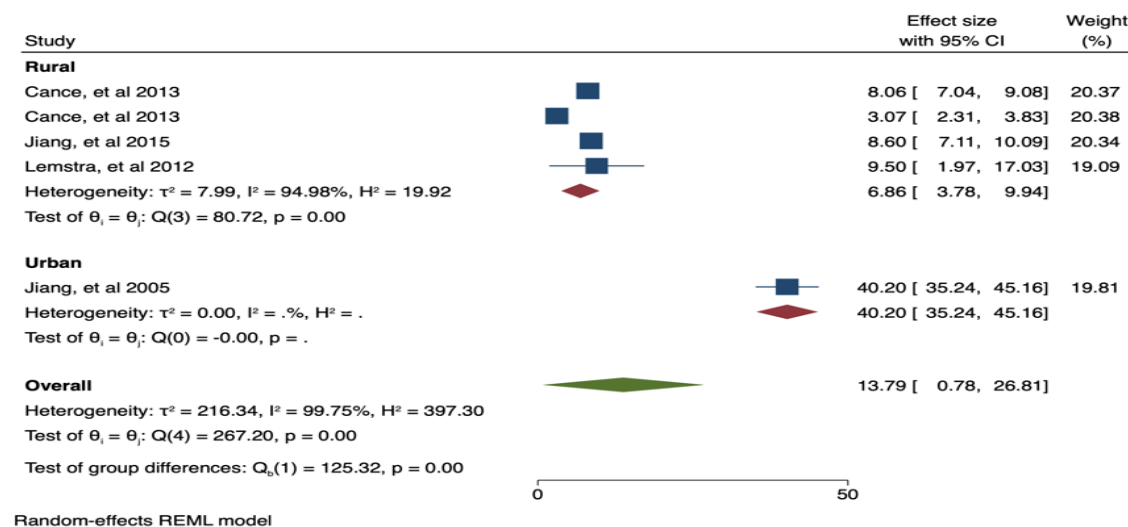

Rural 10- to 11-year-old children had a combined prevalence of 6.9% (95% CI 3.8-9.9) whereas those residing in urban areas was for only the one study Jiang et al 2005, 40.2% (95% CI 35.2-45.2). The urban prevalence of alcohol use among 10- to 11-year-old children was significantly higher than in rural children. The studies involved however, did not show why this difference was noted. This could be a chance finding since it has a small sample size and may not be generalized but there is need for further research into why this is happening. In both locations, the confidence intervals around the effect estimates were relatively precise and the findings were statistically significant.

A funnel plot was drawn to determine publication bias and it showed asymmetry. This plot showed that publication bias was present as expected from small studies. Most studies lied to the right of the funnel showing that the studies that presented larger prevalence were preferred to be published rather than

those with a smaller prevalence size. This finding should be interpreted with caution because the studies in the funnel plot were less than 10 which means that the studies were too few to make a valid funnel plot (61). Other possible explanations for such a funnel plot could be due to the high heterogeneity between the studies or a chance finding. This could indicate a need for analysis with a larger number of studies and the studies should have large sample sizes.

*Figure 4 showing funnel plot for the 10- to 11-year-old prevalence data*
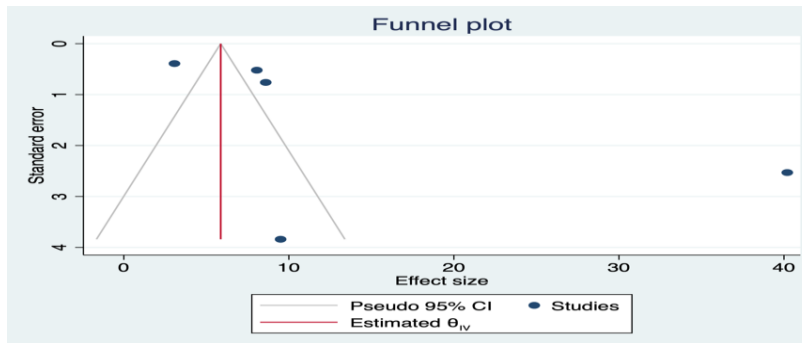
Alcohol use by age: 12 to 13 years

A subgroup of 12- to 13-year-old was formed and the reported prevalence of alcohol use among 12- to 13-year-old children was analysed in a forest plot.

The forest plot showed that among rural abiding children, the overall prevalence of alcohol use was 18.2% (95% CI 13.5-23.0) and among urban children it was 31.9% (95% CI 22.8-41.1). Most of the rural studies included in this forest plot had narrow confidence intervals. The heterogeneity was at 99.02% which is high. For the urban studies, the confidence intervals were more widespread meaning that there was a lower precision of the data reported.

Figure 5 showing a forest plot of studies reporting on prevalence of alcohol use among 12- and 13-year-old children according to rural and urban location
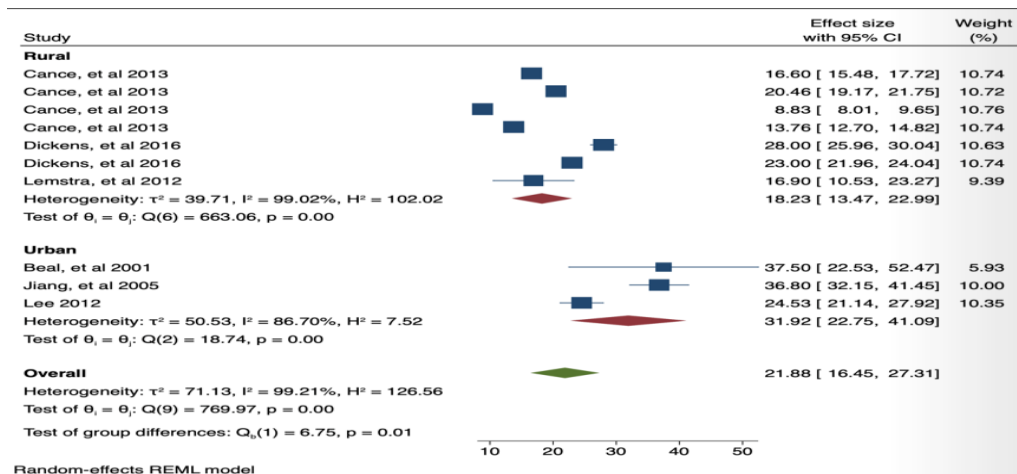
A funnel plot was drawn for the data on prevalence of alcohol use among 12- to 13-year-old children to assess publication bias.

Figure 6 showing funnel plot of studies which presented prevalence of alcohol use among 12- to 13-year-old children
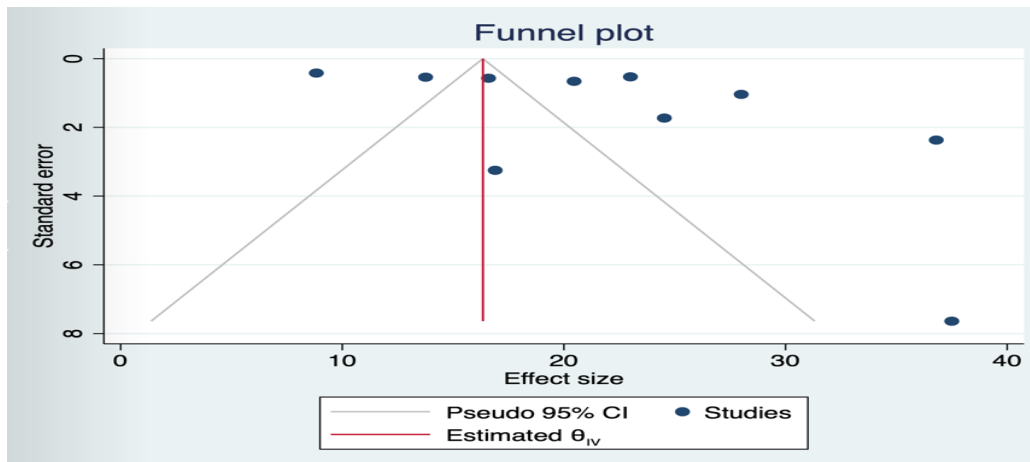

The funnel plot above showed that there was asymmetry, which could mean publication bias, chance or just the high heterogeneity. The studies published show that they had lower standard error but a wide range of effect size. On the plot, many of the studies were plotted on the higher end of the effect size (prevalence) and only two were on the lower end of the effect size which could mean that studies with high prevalence were published more than those with lower prevalence.

Alcohol use by geographical location: China

A subgroup of studies published by country was also included for meta-analysis. A forest plot was drawn to compare prevalence by country but since there were very few studies for each country and only the USA had more studies. We decided to analyse 7 studies by countries which had more than one study. The rest of the countries had one each for Norway, Brazil, Canada and Australia and so could not be included in this forest plot. Studies with pooled effect were also omitted e.g., in this case Jaisoorya et al 2016 was conducted in India but was excluded since it showed pooled results only.

Figure 7 showing forest plot of studies conducted in China by rural and urban location
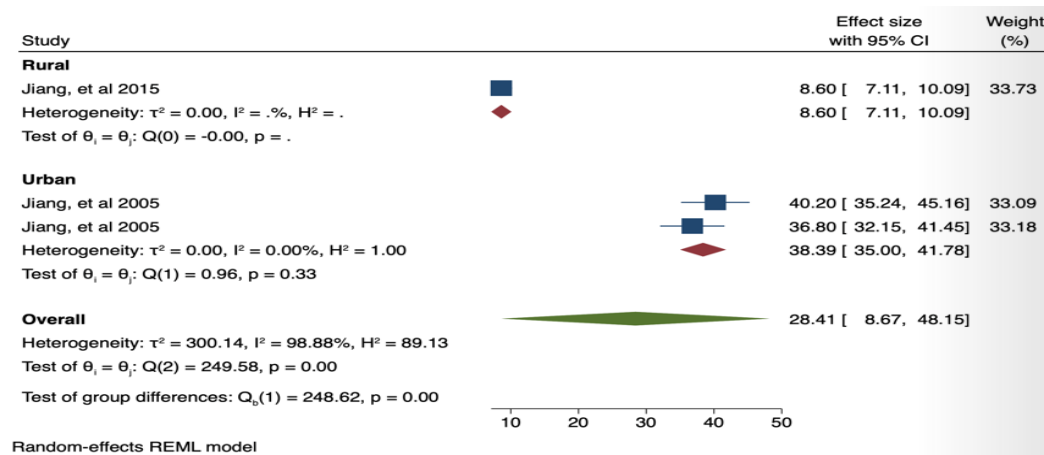

The 2 papers were both conducted in China and presented findings in urban and rural children. The rural prevalence was from only one paper, and it was 8.6% (95% CI 7.1-10.1). For the urban children, prevalence of alcohol use was 38.4% (95% CI 35.0-41.8). Jiang et al 2005 reported prevalence of alcohol use among 12- and 13-year-old children disaggregated by age and both these values were included in the meta-analysis. Urban dwelling children had a higher prevalence of alcohol use compared to rural dwelling children, and this was statistically significant.

Alcohol use by geographical location: USA

This subgroup included studies conducted in the USA. A total of 7studies conducted in the USA were included in this meta-analysis (31,45,48,49,53,54,59).

Figure 9 showing alcohol use in North America by rural and urban location
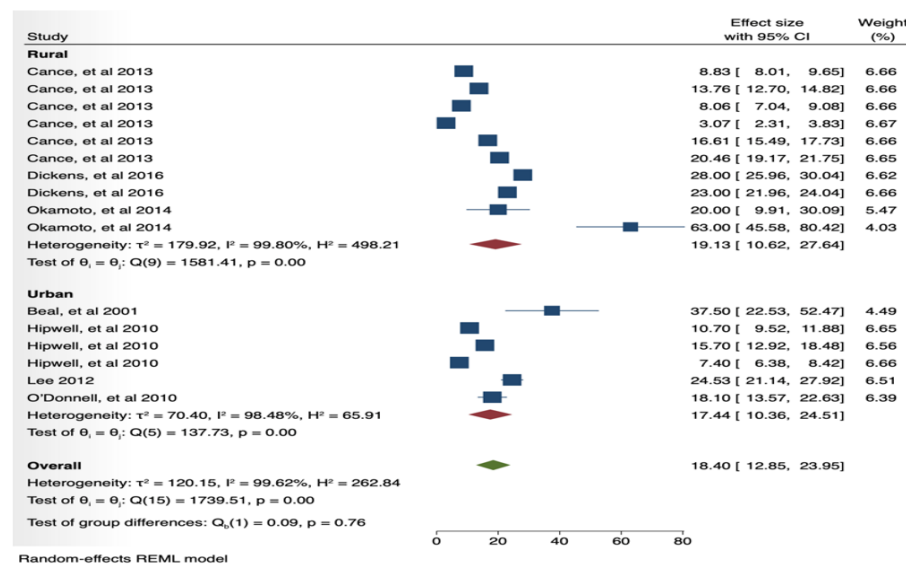
In some of the 7 studies included in the forest plot, the authors gave prevalence disaggregated by age. For example, Cance et al 2013 reported on a rural sample of children aged 11 to 13.5 years with age disaggregates by 0.5 years from 11 to 13.5 years (45). All the prevalence rates reported were taken as individual prevalence and included as such in the analysis. Studies conducted in rural areas showed a combined prevalence of 19.1% (95% CI 10.6-27.6) whereas for urban studies showed 17.4% (95% CI 10.4- 24.5). This shows that alcohol use in rural USA among 10- to 13-year-old children was almost the same in rural and urban areas with a slightly higher rate in rural areas. The prevalence rates in urban and rural USA studies show overlapping which means that we cannot be certain that there is a difference in these alcohol use prevalence values.

The forest plot for the studies conducted in the USA shows that even though the plot is not symmetrical, the studies were not as widely scattered as the funnel plots for the other subgroups. There are 5 prevalence estimates on the left side of the midline compared to 11 on the right side of the midline and this may be due to heterogeneity which is seen in the forest plot or publication bias.

Figure 10 showing a funnel plot of the studies conducted in North America
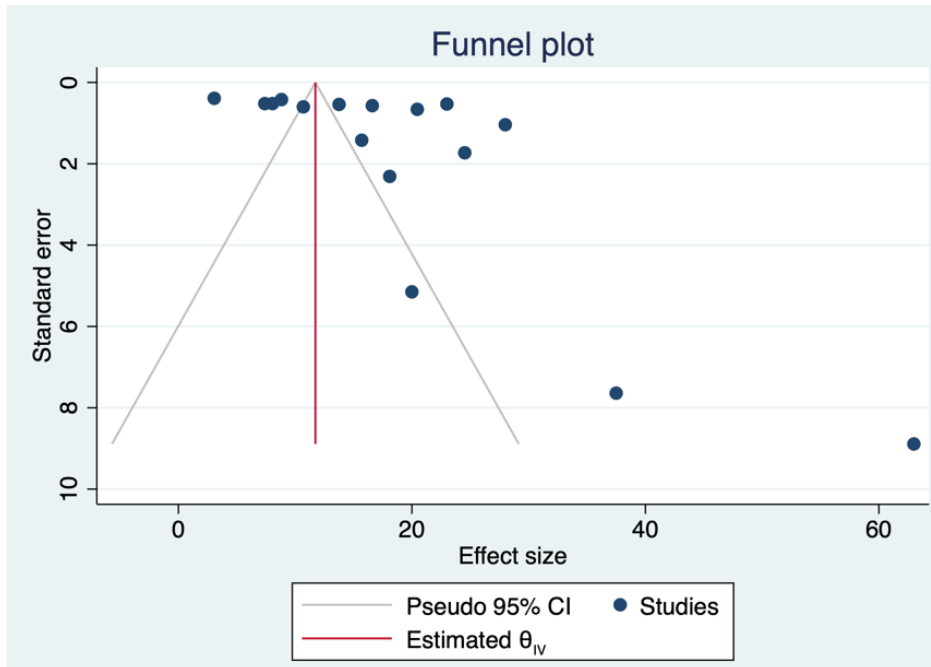
Analysis of Associated factors

One of the objectives of this thesis was to investigate factors associated with early drinking and whether they were different according to urban/rural residence in the age group of interest. Relevant factors identified in the papers include family factors and peer influence among 10 to 13.5 years of age. The other factors were not analysed due to being reported in one study only, and race was not reported because it was not associated with urban and rural dwelling.

Family factors

Studies included in this review reported on family factors as playing a role in the alcohol use of the children in our age group of concern however, these studies did not compare the factors among rural and urban divide to show if location had any bearing on the factors behind alcohol use in children. To answer our second objective, there was need for uniquely attributable factors to location and this information was not obtained from the studies included.

Most studies reported on the role of family factors on children's drinking habits but not as a unique attribute of the location of residence (48,49,51–54). According to Hemphill et al 2007, who reported on pooled prevalence for urban/rural residence, reported that parents who were non-native English speakers in Australia had children who used less alcohol (OR 0.4, 95% CI 0.2-0.8, p<0.05). Jaisoorya et al 2016, who also reported pooled prevalence, showed that living with relatives other than one's parents was associated with higher odds of being a lifetime alcohol user than living with both parents (OR 1.2 95% CI 0.8 to 1.8) or living with a single parent (OR 1.4 95% CI 1.0 to 1.8). The former is not significant since it includes one in the confidence interval.

Okamoto et al 2014 studied alcohol drinking among Native and non-native Hawaiian youths and reported higher alcohol use among native Hawaiian youths (49). Among the factors they studied was if family offers alcohol and other substance used. Among native Hawaiian youths, they reported greater odds of drinking alcohol if they were offered by a relative or parent (OR 17.3, no CI reported) compared to non- Hawaiian youths. It is likely that parental offers of alcohol led to increased alcohol use.

Dickens et al 2018 studied rural African American and white adolescents in the USA, reported odds ratios for parental permissiveness for white and African American 12-year-old girls (54). One standard deviation increase in parental permissiveness was associated with relative odds of 1.5 for white girls and 1.3 for black girls (no CI reported) showing that parental permissiveness is associated with increased alcohol use among these rural dwelling children.

Lee 2012 studied urban adolescents and found that parental monitoring was negatively associated with alcohol drinking but did not report on OR (53).

O'Donnell et al 2010, reported on an intervention which focused on parental communication with their daughters on delaying alcohol and sex initiation among urban children. The group who had the intervention showed the intervention to be protective of alcohol use (AOR 0.4, CI=0.2 to 0.9,p<0.05) compared to the control group.

Beal et al 2001 also who studied urban children reported that their participants reported less influence on drinking alcohol from parents compared to other factors e.g., peers and age. Beal et al 2001 did not report the odds ratios for the association between parental influence and child alcohol use.

From these studies, it shows that the parents and family have a role to play in influencing and thereby affecting their children's alcohol use however, it is not possible to compare this effect between rural and urban children because the studies only report for one location and are not comparing between the 2 locations.

Peer influence

Three studies reported on peer influence on alcohol intake among the selected studies. These included Beal et al 2001, Okamoto et al 2014 and Dickens et al 2018 (49,54,59). Beal et al 2001 a study on urban

settings, reported that peer disapproval was associated with reduced alcohol use (59). They also reported that peer influence was more important than parental influence in affecting children alcohol use. Okamoto et al 2014 studied rural youths and reported that peer pressure had lower odds of influencing adolescents to take alcohol when compared to family factors (OR 0.6, SE 0.6) but higher in influencing them to smoke cigarettes (OR 1.5 SE 0.5). Dickens et al 2018 reported that one standard deviation change in peer use was associated with higher odds of alcohol use in adolescents (African Americans OR 1.9 and White Americans OR 2.8). From these 3 studies it shows that even though peer influence directly affects alcohol use in youths in our age of interest, it is not a simple and straightforward relationship. However, there was no systematic difference between the effects of peer influence in urban/rural settings since among rural youths, some report to be influenced by peers while others do not report to be influenced by peers to take alcohol across our 3 studies.

DISCUSSION

This systematic review looked at peer reviewed research papers published between 2000 and 2019 January looking at alcohol use among 6- to 13-year-old children living in rural and urban areas. The specific criteria for inclusion were age and rural or urban location. There were several studies that reported on alcohol use among children but did not qualify to be part of this systematic review due to various reasons. The commonest was not reporting age of participants in years, they reported other measures of age namely year of school and grade. Another challenge was that several studies that had reported urban and rural alcohol use, did not disaggregate prevalence of alcohol use by age instead reported on an age group. This led to inclusion of 15 studies that met the criteria.

During this systematic review, there were challenges observed during the data extraction and synthesis stages. The data obtained from the identified studies was reported without uniformity and were heterogenous. One study reported on binge drinking (53) while another reported on alcohol abuse and alcohol dependence (47). The main objective of this systematic review wanted to compare prevalence of alcohol use in rural and urban locations without delving into details of frequency so during the analysis stage, we formed subgroups by placing data on lifetime alcohol use separate from other frequencies of alcohol use namely binge drinking, alcohol dependency and alcohol abuse. We ended up having 3 subgroups: lifetime alcohol use, binge alcohol drinking and alcohol dependency. The latter 2 groups had only one prevalence measure each so they could not be incorporated into the forest plot. Borenstein et al 2013 recommends to conduct a meta-analysis of a subgroup when it has more than one study (62). The lifetime alcohol use was reported in 6 studies (31,48,49,53,56,58). The prevalence was reported in for urban (31,48,53,58) and rural (49,56) alcohol use.

Another observation was on age of alcohol use. When analysis was done on all the age groups reported, i.e., from 10 to 13 years, the heterogeneity was observed to be high. Therefore, we formed subgroups by age whereby 2 broad age groups were formed (10- to 11-year-old, and 12- to 13-years-old children). We observed that there were no data reported for children aged less than 10 years. This does not mean that there are no studies on alcohol consumption in this age group. It only means that among studies that reported on rural and urban alcohol use, these children were not studied in this context.

Due to the high heterogeneity noted in the analysis, we formed another subgroup whereby alcohol use by country where the study was conducted were analysed. For the country subgroup, only 2 groups

were formed, and they were USA and China. For the rest of the studies, there were only one study per country which were not included in models on geographical criteria. For the subgroups, heterogeneity was still high of >90% despite being analysed in subgroups.

The meta-analyses were displayed on forest plots and the findings showed that after subgroup analysis, the prevalence of alcohol use in rural areas was lower than in urban areas. This was the case with the 10- to 11-year-old, 12- to 13-years-old and in the China subgroup. These findings show that urban dwelling adolescents use more alcohol compared to rural ones as was observed in Brazil (55). The study was of 13 to >16-year-old adolescents and urban alcohol use was 24.1% (95% CI 23.4-24.7) while rural was 20.8% (95% CI 19.1-22.6). However, the confidence intervals were overlapping which means that we cannot say that the findings are significant. Most of the studies focused on either urban or rural areas only and not comparing both in the same study as was seen in this Brazil paper.

The studies conducted in the USA showed that rural prevalence of alcohol use was higher than the urban one howbeit slightly so. The USA subgroup findings correspond to findings reported by Jiang et al 2008 for Canada (13) who showed increasing alcohol use by rural youths compared to urban ones. These findings also were similar to those reported by Kogan et al 2006 where they report on rural dwelling youths consuming alcohol at higher rates than urban ones (23). They also noted that among males, urbanicity was linked to abstinence from alcohol use. This is showing that in North America, alcohol use prevalence is higher in rural than urban areas.

These findings are different for reported findings in African studies. Ogunsoola et al 2017 reported that among 10- to 19-year-olds in Nigeria, alcohol use was higher among urban than rural dwelling youths (11) corresponding with the findings in this study. However, the prevalence reported were not too different (58.3% for rural and 62.3% for urban populations without the confidence intervals).

The findings in this study have limitations. There were no papers from Africa, the middle East and South America. This means that the findings cannot be generalized to areas beyond those specifically studied by individual researchers. The fact that several papers were not included because they did not specify age just the academic year and grade further limits generalizability of these review findings as it narrows the study population. Additionally, there were few papers included in the review most of which were conducted in the USA, further limits generalizability. However, the findings show more alcohol consumption among urban areas than rural areas among our age group of interest pointing out to a possibility of greater alcohol use in urban dwelling children than rural ones.

CONCLUSION

This study confirms that alcohol is being used by children between the ages of 10 and 13 years regardless of their location of residence. It is evident that children access alcohol in private or public places. Even though there are laws against this practice, they are not kept.

Rural areas were found to have lower prevalence of alcohol use in this systematic review compared to urban areas however, the factors associated with alcohol use were not specific to a particular setting. Therefore, carefully designed interventions are needed to reduce alcohol use among children in all

settings. Further research should investigate associated factors by location and focus on actionable interventions.

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SUPPORTING INFORMATION

Appendix A: Search terms, Database's search strategies

Appendix 1: Search strategy

Database: Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily <1946 to January 09, 2020>

Database: Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily <1946 to January 09, 2020>

Search date: 2020-01-10

Search Strategy:

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1   underage drinking/ (772)

2   (underage drinking or youth drinking or teen drinking or teenage drinking).ti,ab. (564)

3   (Alcohol adj3 ("use" or abuse or abusing or misusing or misuse or drink* or consumption or consuming or intake)).ti,ab. (112067)

4   (("illicit drug" or "illegal drug" or substance* or hallucinogen* or cocaine or marijuana or cannabis) adj3 ("use" or abuse or abusing or misusing or misuse or intake or consumption or dependen* or addict*)).ti,ab. (85616)

5   ((drug or amphetamine* or stimulant* or benzodiazepine* or opioid* or codeine or glue* or thinner* or inhalant* or solvent*) adj3 ("use disorder" or abuse or abusing or misusing or misuse or sniffing or dependen* or addict*)).ti,ab. (57367)

6   1 or 2 or 3 or 4 or 5 (225477)

7   (child or children* or childhood or kids or adolescen* or teen* or youth* or school or "young people").ti,ab. (1618210)

8   6 and 7 (40267)

9   ("drug use" adj4 (child or children* or childhood or kids or adolescen* or teen* or youth* or school)).ti,ab. (2204)

10   8 or 9 (41075)

11   prevalence/ (281306)

12   (prevalence or occurence or epidemiolog* or cross-sectional or survey or cohort).ti,ab. (1916721)

13   11 or 12 (1976841)

14   10 and 13 (16003)

15   limit 14 to yr="2000 -Current" (13744)

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Database: Embase <1974 to 2020 January 14>

Search date: 2020-01-16

Search Strategy:

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1   underage drinking/ (1042)

2   (underage drinking or youth drinking or teen drinking or teenage drinking).ti,ab. (677)

3   (Alcohol adj3 ("use" or abuse or abusing or misusing or misuse or drink* or consumption or consuming or intake)).ti,ab. (158133)

4   (("illicit drug" or "illegal drug" or substance* or hallucinogen* or cocaine or marijuana or cannabis) adj3 ("use" or abuse or abusing or misusing or misuse or intake or consumption or dependen* or addict*)).ti,ab. (112878)

5   ((drug or amphetamine* or stimulant* or benzodiazepine* or opioid* or codeine or glue* or thinner* or inhalant* or solvent*) adj3 ("use disorder" or abuse or abusing or misusing or misuse or sniffing or dependen* or addict*)).ti,ab. (75596)

6   exp drug abuse/ (115275)

7   1 or 2 or 3 or 4 or 5 or 6 (366772)

8   (child or children* or childhood or kids or adolescen* or teen* or youth* or school or "young people").ti,ab. (2010873)

9   7 and 8 (57929)

10   ("drug use" adj4 (child or children* or childhood or kids or adolescen* or teen* or youth* or school)).ti,ab. (2674)

11   9 or 10 (58697)

12   prevalence/ (684849)

13   (prevalence or occurence or epidemiolog* or cross-sectional or survey or cohort).ti,ab. (2723541)

14   12 or 13 (2851725)

15   11 and 14 (22659)

16   limit 15 to yr="2000 -Current" (19916)

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Database: PsycINFO <1806 to January Week 1 2020>

Search date: 2020-01-16

Search Strategy:

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1   underage drinking/ (701)

2   (underage drinking or youth drinking or teen drinking or teenage drinking).ti,ab. (614)

3   (Alcohol adj3 ("use" or abuse or abusing or misusing or misuse or drink* or consumption or consuming or intake)).ti,ab. (65271)

4   (("illicit drug" or "illegal drug" or substance* or hallucinogen* or cocaine or marijuana or cannabis) adj3 ("use" or abuse or abusing or misusing or misuse or intake or consumption or dependen* or addict*)).ti,ab. (85111)

5   ((drug or amphetamine* or stimulant* or benzodiazepine* or opioid* or codeine or glue* or thinner* or inhalant* or solvent*) adj3 ("use disorder" or abuse or abusing or misusing or misuse or sniffing or dependen* or addict*)).ti,ab. (35223)

6   exp "substance use disorder"/ (126746)

7   1 or 2 or 3 or 4 or 5 or 6 (205000)

8   (child or children* or childhood or kids or adolescen* or teen* or youth* or school or "young people").ti,ab. (1012316)

9   7 and 8 (50519)

10   ("drug use" adj4 (child or children* or childhood or kids or adolescen* or teen* or youth* or school)).ti,ab. (2673)

11   9 or 10 (51226)

12   morbidity/ (5475)

13   (prevalence or occurence or percentage* or epidemiolog* or cross-sectional or survey or cohort).ti,ab. (484066)

14   12 or 13 (487358)

15   11 and 14 (14451)

16   limit 15 to yr="2000 -Current" (12239)

****

Database: Web of Science Core Collection <1945 - 2020>

Search date: 2020-01-16

Search Strategy:

# 1	944	TS=("underage drinking" OR "youth drinking" OR "teen drinking" OR "teenage drinking")
# 2	128,340	TS=(Alcohol NEAR/2 ("use" OR abuse OR abusing OR misusing OR misuse OR drink* OR consumption OR consuming OR intake))
# 3	117,832	TS=(("illicit drug" OR "illegal drug" OR substance* OR hallucinogen* OR cocaine OR marijuana OR cannabis) NEAR/2 ("use" OR abuse OR abusing OR misusing OR misuse OR intake OR consumption OR dependen* OR addict*))
# 4	78,703	TS=((drug OR amphetamine* OR stimulant* OR benzodiazepine* OR opioid* OR codeine OR glue* OR thinner* OR inhalant* OR solvent*) NEAR/2 ("use disorder" OR abuse OR abusing OR misusing OR misuse OR sniffing OR dependen* OR addict*))
# 5	274,923	#4 OR #3 OR #2 OR #1
# 6	2,329,369	TS=(child OR children* OR childhood OR kids OR adolescen* OR teen* OR youth* OR school OR "young people")
# 7	61,155	#6 AND #5
# 8	2,951	TS=("drug use" NEAR/3 (child OR children* OR childhood OR kids OR adolescen* OR teen* OR youth* OR school))
# 9	62,081	#8 OR #7
# 10	2,796,515	TS=(prevalence OR occurence OR epidemiolog* OR "cross-sectional" OR "cross sectional" OR survey OR cohort)
# 11	26,148	#10 AND #9
# 12	23,619	#11 *Indexes=SCI-EXPANDED, SSCI, A&HCI, ESCI Timespan=2000-2020*

Database: Cochrane CENTRAL <? - 2020>

Search date: 2020-01-16

Search Strategy:

ID   Search Hits

#1   MeSH descriptor: [Underage Drinking] explode all trees   69

#2   ("underage drinking" OR "youth drinking" OR "teen drinking" OR "teenage drinking"):ti,ab 63

#3   (Alcohol NEAR/3 ("use" OR abuse OR abusing OR misusing OR misuse OR drink* OR consumption OR consuming OR intake)):ti,ab   12319

#4   ((("illicit drug" OR "illegal drug" OR substance* OR hallucinogen* OR cocaine OR marijuana OR cannabis) NEAR/3 ("use" OR abuse OR abusing OR misusing OR misuse OR intake OR consumption OR dependen* OR addict*)):ti,ab   10417

#5   ((drug OR amphetamine* OR stimulant* OR benzodiazepine* OR opioid* OR codeine OR glue* OR thinner* OR inhalant* OR solvent*) NEAR/3 ("use disorder" OR abuse OR abusing OR misusing OR misuse OR sniffing OR dependen* OR addict*)):ti,ab   6045

#6   {OR #1-#5}   24732

#7   (child OR children* OR childhood OR kids OR adolescen* OR teen* OR youth* OR school OR "young people"):ti,ab   138339

#8   #6 AND #7   3813

#9   ("drug use" NEAR/4 (child OR children* OR childhood OR kids OR adolescen* OR teen* OR youth* OR school)):ti,ab 196

#10   #8 OR #9   3862

#11   MeSH descriptor: [Prevalence] explode all trees 4850

#12   (prevalence OR occurence OR epidemiolog* OR "cross-sectional" OR "cross sectional" OR survey OR cohort):ti,ab,kw   164890

#13   #11 OR #12   164890

#14   #10 AND #13 with Publication Year from 2000 to 2020, in Trials   1098

Appendix B: Descriptions of individual studies

This review looked at prevalence of alcohol use among 6- to 13-year-old children in the context or rural or urban settings. The main outcome looked at was prevalence. The 15 studies included in the review were heterogenous and the prevalence reported ranged from 0% (47) in Virginia, USA to 63% (49) among Hawaiian youths also in the USA. None of the studies reported associated factors in terms of settings; the associated factors were not linked statistically to urbanicity or rural settings. Therefore, the associating factors were not analyzed in this study but only narrated.

1.*The Monitoring young lifestyles (MyLife) - a prospective longitudinal quantitative and qualitative study of youth development and substance use in Norway* by Brunborg et al, 2019, aimed to look at correlates, causes and consequences of substance use among adolescents in Norway. It is a mixed methods study conducted in both rural and urban Norway. The sample size consisted of 3512 adolescents aged between 13 and 16 years across different socioeconomic statuses. The study compared associated factors such as parent-child relationships, risks and protective factors like peers, health and diet, stress, school and alcohol use. Among 13-year-old, 9.3% reported to have ever consumed alcohol and 2.3% had done so in the past 30 days. This study was a prospective study so it is unique in that it can identify a pattern of substance use across the years it will be implemented, i.e., 2017 to 2021. The possible source of bias for this study identified by the authors is that vulnerable children could avoid filling the surveys and hence cause a selection bias. This bias could lead to a lower estimate of alcohol use among this age group because those who are most likely to use will not participate in the study.

2.*Prevalence of mental health disorders among low-income African American adolescents* by Byck et al, 2013 is a study that looked at prevalence of mental disorders among low-income African American youths living in urban areas and exposure to alcohol and other substance use and dependence. The study is a quantitative study conducted in urban USA with sample size of 23,163 students aged 12 to 18 years, however, our age of interest included 592 10- to 13-year-old children. The associated factors studied were conduct disorders, PTSD, major depression and these were assessed using validated tools. The odds ratio for increasing using alcohol were 1.53 with increase in age. Prevalence of alcohol abuse and dependence among 10- to 13-year-olds was 0%. A possible source of bias is that the data is self-reported and so social desirability may lead the participants to report less alcohol use leading to a lower prevalence estimate.

3.*Alcohol consumption among rural African American and white adolescents: The role of religion, parents, and peers* by Dickens et al, 2016 looked at psychosocial factors and adolescent use of alcohol in rural areas. It is a quantitative cross-sectional study conducted in the USA. It included 23,163 adolescents aged 12 to 18 years. The exposure of interest was alcohol use and the survey used a validated community tool. The factors of interest included religion, parental permissiveness and peer use. The odds for a 13-year-old to drink alcohol were higher than for a 12-year-old meaning that more children start alcohol use as they age. The paper also showed that white children used more alcohol than African American children. The prevalence of last month alcohol intake among 13-year-olds was 23% (SD 0.42) for African Americans whereas for whites of the same age was 28% (SD 0.45). The authors concluded that alcohol use among African American youths was less than whites. This was a cross sectional study on data collected years before (1997 to 2002) so its main focus was to look at relationships between races. It may not reflect the actual prevalence in the present. This is a possible bias in this systematic review that may affect results in an unpredictable way. If prevalence has

increased, this will mean that this prevalence reported will lower the current prevalence and the opposite is true if the current prevalence is higher than this reported.

4.*Perceived pubertal timing and recent substance use among adolescents: a longitudinal perspective* by Cance et al, 2013 aimed to study longitudinal associations between puberty timing and substance use among 11- to 17-year-olds. This descriptive quantitative study sampled 6425 youths aged 11 to 17 and looked at substance use including alcohol use. The associated factors were puberty timing and substance use. The odds ratios were not reported however, prevalence of alcohol use by age was reported and it ranged from 3.06% for 11-year-old to 20.46% for 13.5-year-old showing a characteristic rise in prevalence of alcohol use with age. The study showed that adolescents who reported earlier pubertal development used alcohol and other substances earlier than those who reported late puberty. This may have been due to them appearing older or associating with older children whilst not having adequate coping capabilities to peer influence. This study looked at relationships between onset of puberty and alcohol use. The questionnaires were designed to capture alcohol use in the past 3 months so there is a possibility of not getting prevalence of alcohol use for those who use alcohol long before that. This could affect the results of this systematic review by either showing a lower than actual prevalence of alcohol use.

5. *Adolescents' Expenditure on Alcohol: A Pilot Study* by Hemphill et al, 2007 aimed to study how underage adolescents access alcohol and how much they spend on it. It is a quantitative cross-sectional study conducted in urban and rural settings and sampled 187 adolescents aged 13 to 18 years. The data was conducted using a survey tool via a one-time interview at a shopping mall. The associated factors included demographics, economic status, employment and other consumer items bought. The study showed that having a non-native English-speaking parent was protective of alcohol use OR 0.4 (CI: 0.2 to 0.8, p<0.05). Prevalence of alcohol use among 13-year-old children in this study was 5%. The study observed that underage children managed to buy alcoholic drinks against the law. These adolescents were willing to spend money on alcohol based on a perceived good taste. The source of bias for this study is from the sampling method which was convenience sampling. Selection bias may result from non-response.

6. *Prevalence and correlates of alcohol use among adolescents attending school in Kerala, India* by Jaisoory et al, 2016 aimed to study prevalence, patterns and correlates of alcohol use by adolescents in Kerala in India. This quantitative, cross-sectional study was conducted in both rural and urban populations. The sample was 7350 of 12 to 19 years old adolescents. The exposure was alcohol and other substance use. The associated factors studied included sociodemographic information, alcohol, and other substance use. Prevalence of alcohol use among 12- to 13-year-old children was 9.9%. This study noted that the age of alcohol initiation had decreased from 16 years to 13.6 years. Adolescents were initiated during family gatherings and through peers. The study looked at school going children only and since this was a cross sectional study, it cannot establish cause and effect. Since the study did not look at out of school youths, it is possible that the prevalence reported is lower than expected resulting in lower prevalence for the systematic review.

7. *Alcohol consumption is higher among left-behind Chinese children whose parents leave rural areas to work* by Jiang et al, 2015 looked at effect of parents' migration on children's drinking habits in rural China. This quantitative cross-sectional research sampled 1367 10- to 14-year-old children in the community among whom 781 were left behind by parents who migrated to cities. Among those who

lived with their parents, 7.8% used alcohol. A survey was used to determine several factors as well as prevalence of alcohol use. The odds for 13- to 14-year-olds to take alcohol was 1.22 (0.73-2.03) and the odds for alcohol use were higher for children whose parents migrated. Prevalence of alcohol use among 10 to12 year old children was 8.6%. the study also noted that the age of alcohol initiation was higher than previously reported and being an only child was protective of alcohol use. This study was conducted during the school break which may mean that some children travelled, and the prevalence is of only those who had remained in the village. It may not affect this systematic review since this review only looked at those children who lived with their parents.

8. *Community violence exposure and adolescent substance use: does monitoring and positive parenting moderate risk in urban communities?* by Rosalyn Lee, 2012 looked at effect of monitoring and positive parenting in moderating the effect of violence exposure and alcohol use among adolescents in urban USA. This is a quantitative cross-sectional study with a sample of 2197 with age categories ≤13 year, 14-15 years and 16-18 years. The exposure was to violence in the community and whether positive parenting and monitoring aided in lowering alcohol use. Associated factors investigated were race, family structure, peers, community violence exposure and victims and perpetrators of violence. The odds ratio of alcohol or drug use was 1.4 for each SD increase in witnessing a crime. Prevalence of alcohol use among age category ≤13years was 24.5% with 6.8% binge drinking alcohol. The author commented that even though other studies showed that protective parenting was protective against community violence, this study showed that it was not and that it was best for adolescents not to be exposed to violence at all. This study based on recollection of several information, and this is a possible source of bias. The bias may affect the results by either increasing or decreasing alcohol use prevalence.

9. Prevalence and risk indicators of alcohol abuse and marijuana use among on-reserve First Nations youth by Lemstra et al, 2012 studied prevalence of alcohol and marijuana use among First Nation adolescents living in a reserve in rural Canada. This is a quantitative cross-sectional study with a sample size of 271 adolescents aged 10 to 16 years old. The sample was categorized into 10 years, 11 to 12 years and 13 to 16 years. The exposure to alcohol and marijuana was determined via a one-time interview. Validated tools were used to determine associated factors. Prevalence of alcohol use was 9.5% for 10-year-olds, for 11 to 12 years old it was 16.9%. odds ratios were not reported. This study was a first of its kind as it investigated substance use among natives in their reservation. Prevalence of alcohol use was 23.5%. Risk factors for alcohol use included older age, smoking, females, leaving home and marijuana use. A possible source of bias could have arisen from the questionnaire used which asked if a participant were ever drunk. This question was used to assess alcohol use. It could lead to under-reporting alcohol use if one took alcohol but did not get drunk. This could affect the systematic review by lowering the prevalence of alcohol use.

10. *Social influences on health-risk behaviours among minority middle school students* by Beal et al, 2001, compared parents' and peers' social influences effect on health risk behavior in minority youths. This quantitative cross-sectional study was conducted in urban USA. The study sampled 208 12- to 13-year-old and ≥ 14year old. The exposure studied was alcohol use, cigarette and marijuana use and sexual intercourse and looked at parental and peer influences on substance use. The tool used was a survey instrument for parental and peer approval. The prevalence of alcohol use was 37.5% among 12 year old children. This study showed that peer influences were stronger than parental influence in alcohol intake. this study used a questionnaire to study behaviour and this could be a source of bias. It is

not possible to predict how this bias could affect the systematic review since it could either increase or decrease the prevalence of alcohol use in the studied population.

11. *Early predictors of sexually intimate behaviors in an urban sample of young girls* by Hipwell et al, 2010 determined to find out the prevalence and predictors of sexual intimate behaviors at age 12 years in urban populations. This was a descriptive study of a sample of 1116 11-year-old girls. The exposures include lifetime alcohol use, deviant peer behavior and poor communication between parent and child. The associated factors studied include socioeconomic status, race, alcohol use, delinquency, depression and conduct disorders. The prevalence of alcohol use was 10.7% while African Americans was 7.4% and whites was 15.7%. The study was conducted using face to face interviews which may have made some participants uncomfortable to participate and hence become a possible source of bias.

12. *Especially for daughters: parent education to address alcohol and sex-related risk taking among urban young adolescent girls* by O'Donnell et al, 2010 aimed to evaluate the Especially for Daughters intervention in urban minority girls and parents. This intervention used CDs and other promotional materials to educate parents on how to help their daughters to avoid risky sexual and alcohol drinking. This was a mixed method, randomized field trial conducted in urban USA. The sample consisted of 268 girls aged 11 to 13 years and 258 parents. The study looked at exposure to alcohol, heterosexual behavior, age and ethnicity. The study looked at use of intervention materials and the outcomes of their use on the targeted behaviors. For the participants who used these materials, sexual risks and alcohol use was less in the intervention group than the control group. Prevalence of alcohol use was 14.6% at baseline and after one year of the study it was 14%. This brief intervention showed that it was effective in promoting reproductive health among these girls. This study relied on reported beahviour rather than observed behaviour. It also was noted that the intervention group parents shared their CDs with friends and church members probably resulting in contamination of the study groups. This may affect the prevalence of alcohol use by lowering it since the children will report low prevalence than it really is in communities without any intervention.

13. *The Social Contexts of Drug Offers and Their Relationship to Drug Use of Rural Hawaiian Youth* by Okamoto et al, 2014 studied differences in offers of substance of use among Hawaiian youths. This was a quantitative, cross-sectional study conducted in rural USA. The sample of 249 youths aged 11.92 years (SD 0.85) for native Hawaiians and 11.69 years (SD 0.88) for non-native Hawaiians were studied for use of alcohol and other substances using a questionnaire. Associated factors like peer pressure, family offers, and unexpected drug offers were studied. Peer pressure was related to increased alcohol use (OR 1.78), family offers and context greatly increased alcohol use (OR 17.28), and unanticipated drug offers (OR 2.94). Age (OR 1.48), male gender (OR 1.84), federal lunch preparation and 2 parent household were less associated to alcohol use. The prevalence of alcohol use in lifetime was 63%. The native Hawaiian youths had higher exposure to family offers and higher rates of alcohol and other substance use. The authors noted that the children who were more likely to be alcohol users were denied participation by their parents. This could mean that the prevalence of alcohol use is higher than that reported in this study. This could result in lowering of prevalence estimates in this systematic review.

14. *Co-occurrence and clustering of the four major non-communicable disease risk factors in Brazilian adolescents: Analysis of a national school-based survey* by Ricardo et al, 2019, aimed to study concurrence of NCD risk factors in Brazilian adolescents. This is a mixed methods quantitative and cross-sectional study conducted in rural and urban Brazilian youths. The sample was 101 607, 13- to 16-year-

olds. The risk factors for NCD studied include alcohol use, insufficient physical activities, smoking and consumption of processed foods. The prevalence of alcohol use among 13-year-old was 16.3%. Girls and those of lower socioeconomic statuses were noted to experience all the 4 risk factors. The authors report that this was a self-reported survey. This means that there is a possibility of bias which resulted from under reporting of risk behaviours. This may lower prevalence of alcohol use.

15.Self-assessed dental health, oral health practices, and general health behaviours in Chinese urban adolescents by Han Jiang et al, 2005 studied perception, attitudes, behaviour, and knowledge concerning factors associated with dental health. This was a cross-sectional survey conducted on 2662 children aged 11, 13 and 15 years. Self-administered questionnaires were used to obtain information on how these Chinese adolescents perceived their dental health and their behaviour regarding dentist visits and tooth brushing. Among the factors studied, the authors also asked about alcohol use among these adolescents. They reported that among 11-year-old children, 40.2% had ever tasted alcohol, 36.8% of 13-year-olds had tasted alcohol and 47.3% of 15 year olds had tasted alcohol. The survey was self-reported but since it had a large sample size, it may not have affected our systematic review prevalence estimates.

Appendix C: Table showing OR and prevalence of individual studies

S No	Authors	Year of publication	Aim of the study	Setting	Sample size	Race OR	Parental influence OR	Peers OR	Prevalence	Possible Bias
1	Brunborg, et al	2019	To investigate correlates, causes and consequences of adolescent substance use and other addictive behaviour in Norway	both rural and urban regions	3512 eighth, ninth and tenth graders (55% girls)	_	_	_	9.3% lifetime alcohol use, 2.3% used alcohol in the past 30 days	Information bias due to self-reporting and amounts and frequency not studied.
2	Byck, et al	2013	To investigate prevalence of mental health disorders among low-income urban African American youth	urban	592 of whom 10 were 13 years old	_	_	_	0% for alcohol abuse 0% for alcohol dependence	The data was self-reported hence there is possibility of information bias
3	Cance, et al	2013	To study longitudinal associations between pubertal timing and substance use among 11- to 17-year-olds	urban	6425 ages 11 to 17	_	_	_	11 years old 3.07% 11.5 years old 8.06% 12 years old 8.83% 12.5 years old 13.76% 13 years old 16.61%	Perceived pubertal timing is a perception and so has no imperial way to measure.

No.	Author	Year	Aim	Setting	Sample		OR		Prevalence	Limitations
									13 years old 20.46% This is lifetime alcohol use	
4	Dickens, et al	2016	To study psychosocial factors and adolescents' alcohol use in rural adolescents.	rural	23,163 ages 12 to 18 years	AA OR 1.36 and WA OR 1.16	AA 1.17 (0.57) and WA 1.16 (0.46)	AA 1.64 (0.86) and WA 1.87 (0.92)	0.42% African Americans and 0.45% white Americans This is lifetime alcohol use	Information bias could arise from the question which asks if their friends were drunk. The participants could answer in a negative if they consider that someone drank but was not drunk.
5	Hemphill, et al	2007	The study looked into adolescent expenditure on alcohol and how underage adolescents can access alcohol.	both rural and urban regions	187 aged 13 and 17 years of whom 13 years old are 11	5% sample of 11 adolescents aged 13yrs	OR 0.4 (95% CI 0.2 to 0.8)	No OR reported	5% Lifetime alcohol use	Small, convenience sample which can lead to bias, missing out those who buy at odd hours. Bias due to selection because the interviewers picked and

									chose who to interview.
6	Jaisoory, et al	2016	To study prevalence, patterns and correlates of alcohol use among adolescents in Kerala India	both rural and urban regions	7350 aged 12 to 19 years	_	Single parent OR 0.8 (0.5 to 1.2) compared to both parents 1.0 and relatives 1.1 (0.6 to 1.8)	_	9.90% Lifetime alcohol use	Cross sectional study hence bias could arise from detection and recall bias (information bias),sampling and non-response bias(selection bias)
7	Jiang, et al	2015	To study effect of parental migration on children left behind in rural China and child's alcohol use	rural	1367 10 to 14 years among whom 586 were left behind by migrating parents	_	_	_	7.08% Lifetime alcohol use among 10 to 12 year old children living with their parent	Selection and information bias as reported by authors. Possible recall bias since it asks about drinking in the past 30 days. Child could under report if they consider amount taken

									to be too small.
8	Lee	2012	To study if monitoring and positive parenting moderate relationship between community violence exposure and substance use by adolescents	urban	2197	_	No OR reported	_	6.80% for binge drinking 24.53% any alcohol or drug use among 13 year old and younger	Possible recall bias because time since exposure to community violence was not measured. Another possible source of bias could be on questions of parental monitoring and positive parenting was based on youths' self-report.

| 9 | Lemstra, et al | 2012 | To identify prevalence of alcohol and marijuana use among First Nation adolescents living in the reserve and the independent risk factors associated with these behaviours | rural | 271 aged 10 to 16 years | _ | _ | _ | 10 years old 9.5% and 11–12years old 16.9% | information bias could arise since they were asked if they were ever drunk to determine alcohol abuse. This is subjective. |
| 10 | Beal, et al | 2001 | To compare parent vs peer social influences are associated with health risk behaviours among young minority youths | urban | 208 12 years old 90 (44.1) 13 years old 100 (49.0) | No OR reported | OR 0.85 (0.47 to 1.55) | OR 1.05 (0.76 to 1.46) | 37.50% lifetime alcohol use | Possible bias could arise from detection and recall bias (information bias),sampling and non-response bias(selection bias).Possible under reporting because they were self-reported surveys |

| 11 | Hipwell, et al | 2010 | To find out prevalence and predictors of sexually intimate beahviours at age 12 years in urban populations | urban | 1,116 11 years old | European Americans 15.7% and African Americans 7.4% | _ | _ | 10.70% lifetime alcohol use | Alcohol use recall over one year back could lead to recall bias. Amount and frequency not asked. |
| 12 | O'Donnell, et al | 2010 | It aims to evaluate the Especially for Daughters intervention in urban minority girls and parents | urban | 268 girls aged 11 to 13 years and 258 parents | Latina vs African Americans 0.93 (0.43 to 2.15) p=.001 | AOR 0.38 (CI 0.15 to .97), p=<.05 for those who had CDs compared to control group. Parents managed to talk about alcohol use in intervention group than control group AOR 3.94 (1.38 to 11.2) p=<.05 | _ | 14.60% had used alcohol, 5.6% repeatedly used alcohol and 3.4% had gotten drunk during the baseline At follow up, 18.1% had used alcohol, | May arise out of non-use of the intervention materials e.g., printed materials and CDs. This was a field trial so sharing of the intervention material between case and control groups could lead to bias. |

13	Okamoto, et al	2014	To study differences in multiple drugs offers and multiple drug use among Hawaiian youths	rural	249 aged	Hawaiian 63% vs non-Hawaiian 20%	OR 17.28	OR 1.78	63% (SD 1.06) for native Hawaiians 20% (SD0.59) for non-native Hawaiians	Information bias
14	Ricardo, et al	2019	To study the cooccurrence of NCD risk factors among Brazillian adolescents	both rural and urban regions	101607 ages 13 to 16 years	_	_	_	16.30% of alcohol use among 13-year-old children	Information bias due to self-reporting.
15	Jiang et al	2005	Self-assessed dental health, oral health practices, and general health behaviors in Chinese urban adolescents	urban	2662 ages 11, 13 and 15 of whom 11 and 13 years were 1850	_	_	_	40.2% among 11-year-olds, 36.8% among 13-year-old	Information bias if adult was present with the child during filling of the survey. It is possible that children did not report if alcohol taken was a little since the question wanted drunk. Possible recall bias since it

									was in the past 30 days.