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A critical review of public health interventions aimed at reducing alcohol consumption and/or increasing knowledge among pregnant women

Running title: Review of interventions reducing alcohol in pregnancy

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ABSTRACT

Issues: It is well established that alcohol can cross the placenta to the foetus and can affect both physical and psychological development of the infant; however, many women continue to drink during pregnancy. It is therefore important to determine whether interventions can be successful in reducing alcohol consumption among pregnant women. Past reviews have investigated the effectiveness of clinical interventions in reducing alcohol consumption in pregnancy; however, the aim of the current review was to focus on the effectiveness of public health interventions. **Approach:** A critical literature review was conducted by searching several electronic databases using keywords such as; pregnancy, alcohol, interventions, and public health. Studies were included if they utilised a public health intervention, and included alcohol consumption or levels of knowledge as an outcome measure. **Key Findings:** Ten studies were included in the review. Interventions included multimedia and educational interventions. Improvements in knowledge were reported in six studies, whereas one study found contradictory results. Four studies used alcohol consumption rates as an outcome measure, and although a reduction in consumption was reported, the results were non-significant. **Implications**: The effectiveness of public health interventions that aim to increase awareness and reduce alcohol consumption among pregnant women cannot be assessed because of the paucity of studies. **Conclusions:** The results of this critical review emphasize a lack of evidence and highlight the need for further evaluation research on this topic.

Key words: review, public health, alcohol, pregnancy, interventions

INTRODUCTION

It is well established that alcohol consumption in pregnancy can cross the placenta to the foetus and can affect both physical and psychological infant development [1-3]. Heavy alcohol consumption can result in severe adverse outcomes for the infant including: facial impairments, limb abnormalities, attention problems and learning difficulties [1, 3, 4]. However, there is less evidence of outcomes surrounding low to moderate consumption levels, and there is ongoing debate surrounding the relationship between the amount of alcohol consumed, timing of exposure, and levels of harm in the developing foetus [5-7]. Ultimately, no known safe level of alcohol consumption during pregnancy has been established, as what may be a risk-free amount for one woman may be an unsafe amount for a woman of different background, race, genetics and nutrition [8]. As such, recommendations for alcohol use during pregnancy in most countries advocate abstinence. Despite this, these recommendations have changed dramatically over time, and vary from country to country [5, 9, 10]. Recommendations provided in Australia, Canada, Sweden, and the United States are for total abstinence while polices in Denmark, Switzerland, and the United Kingdom, allow for occasional low amounts of alcohol to be consumed [11].

Alcohol in pregnancy

Despite countries promoting abstinence from alcohol during pregnancy, many women continue to drink even after learning that they are pregnant. In the United States, approximately 7.6% of pregnant women admitted to drinking during pregnancy [12], while in Canada, it is reported that approximately 15% of pregnant women consume alcohol [13]. French figures have observed that up to 47% of women drank alcohol at some stage of their pregnancy [14]. Similar results have been seen in Australia, with recent research indicating that 47.3% of Australian pregnant women drank before knowing about their pregnancy, with

19.5% continuing to drink after learning of conception [15]. While many of these women may be consuming at low levels, the proportion of women consuming alcohol at high risk levels during pregnancy does not appear to be declining [16].

The effects of alcohol in pregnancy

Infants affected by maternal alcohol consumption may develop a range of permanent birth defects, falling under the umbrella term of Foetal Alcohol Spectrum Disorders (FASD). The potential consequences of prenatal alcohol exposure fall along a continuum, ranging from mild learning difficulties and behavioural problems to serious birth defects, poor physical health, and severe behavioural issues [4]. Physical growth defects resulting from alcohol exposure may include lower birth weight, heart defects, and joint and limb abnormalities. Developmental brain defects may result in significant long-term behavioural issues including hyperactivity, increased irritability, and problems with memory and learning [2, 21]. Foetal Alcohol Syndrome (FAS) is the most serious outcome of prenatal alcohol consumption. FAS is characterised by unusual facial features including small eye-openings and thin upper lips, as well as significant developmental delays and behaviour problems. Some infants born with FAS may also have heart defects, and minor limb abnormalities [2]. Estimates of the prevalence of FAS or FASD vary between countries and ethnic groups, and have proved hard to determine due to inadequate diagnoses [4]. In the United States, FAS occurs in 0.5 to 2 cases per 1000 live births, and it has been suggested that rates of FASD could be at least three times higher [22, 23]. The prevalence of FASD in Australia is reported to be approximately six per 1000 live births, although this figure too may be much higher due to under-reporting [24]. The highest rates of FAS occur in South Africa, with approximately 20 cases per 1000 births [25].

Interventions aimed at reducing alcohol consumption and/or increasing knowledge

In an attempt to improve knowledge of the topic and reduce alcohol consumption in pregnant women, a range of interventions have been assessed around the world [26, 27]. These interventions fall into two main categories: clinical or public health approaches. Clinical interventions target individuals and focus on a diagnosis and treatment approach and can include counselling or motivational interviewing, therapy-based approaches (such as Cognitive Behavioural Therapy (CBT)), and one-on-one treatment plans, where the framework remains based on the individual [28]. Public health interventions, on the other hand, place less emphasis on diagnosis and treatment, and concentrate primarily on prevention at a community level. These interventions can include media campaigns, educational interventions, and government regulations [28]. Many public health interventions focus on increasing awareness and improving knowledge among individuals whereas clinical interventions tend to target behaviour change. Prevention strategies for disease can either be based on offering individual help to high-risk individuals, or to control the causes of incidence in the population as a whole. Depending on the health issue, a large number of people who have a small risk may create a more significant problem than a small number of people who are at high risk [29]. With regards to reducing alcohol consumption during pregnancy, clinical interventions can be used to support women at high risk, such as those with alcohol dependence issues. However, public health interventions may be more beneficial for prevention, as they can educate the general public about the harms associated with alcohol use in pregnancy. As well as reducing the consumption of alcohol among pregnant women, it is beneficial to improve the knowledge of these women, and the rest of the population, in relation to the effects of drinking while pregnant, so that the prevalence of alcohol use during pregnancy steadily declines.

Rationale and objectives

FASD is the leading non-genetic cause of birth defects and brain damage in unborn children, and there is as yet no known cure [4]. FASD is entirely preventable, and consequently any interventions that can successfully reduce the rates of FASD will greatly improve long-term health outcomes. While other reviews have focused mainly on clinical interventions aimed at reducing alcohol use among pregnant dependent women [26, 27], the focus of this review is only on public health approaches. This critical review aims to investigate all studies involving pregnant women and women of child-bearing age which utilise a public health intervention (such as multimedia and education campaigns) in order to increase knowledge on the issue of alcohol use in pregnancy, and reduce the consumption of alcohol during pregnancy. The main objective of this critical review is to determine whether public health interventions are effective at reducing alcohol consumption and improving knowledge in samples of women.

MATERIALS AND METHODS

Search strategy

A wide range of health databases were searched in order to identify intervention studies aimed at reducing alcohol consumption in pregnancy. The databases included: CINAHL, Cochrane library, Embase, Johanna Briggs Institute, Medline, PsychInfo, and Scopus. These databases were then searched with a combination of the following terms: (pregnancy, or pregnan*, or prenatal care) AND (alcohol*, or alcohol drinking, or alcohol consumption) AND (intervention*, or health education, or public health, or health promotion). The searches were conducted in March 2014. No date restriction was applied to the searches. Studies identified through this search strategy were screened by title, and abstracts were read where deemed appropriate. In order to identify additional studies, the reference lists of all articles deemed relevant to the current review were searched.

Selection criteria

The central aim of this review was to locate studies employing a public health intervention to reduce alcohol consumption or increase knowledge about the effects of alcohol use in pregnancy. The population of interest was pregnant women, however women of child-bearing age were also included in the population of interest as it has been found that approximately 41% of pregnancies worldwide are unplanned [30]. The focus was on public health interventions such as educational campaigns, social marketing campaigns, and health promotion interventions. The primary outcomes of interest were knowledge of the effects of alcohol consumption on the unborn foetus, and maternal alcohol consumption. Studies that contained either of these outcome measures were included in the review. An English language restriction was applied to all searches.

Inclusion criteria

Studies were included if the sample population was women of child-bearing age (18-45 years) or pregnant women; a clearly defined public health intervention was utilised; and outcome measures of maternal alcohol consumption or levels of knowledge were assessed.

Exclusion criteria

Studies were excluded if their sample population involved health professionals, or women with alcohol abuse problems. Clinical interventions, such as, CBT, motivational interviewing, one-on-one counselling, and home visitations, were excluded from the current review as these have been investigated extensively in past research [26, 27].

Outcome measures

Although the major focus of the review was initially reduction in rates of alcohol consumption in pregnant women and women of child-bearing age, levels of knowledge about

the harms of alcohol consumption during pregnancy were identified in the literature as being a significant aspect of the area. For this reason, studies assessing either alcohol consumption rates or levels of knowledge regarding alcohol consumption in pregnancy were included in the initial screening process.

Quality assessment

The quality assessment tool developed by Moncrieff et al. [31] was used to assess the quality of all studies suitable for review. This involved a rating scale consisting of 23 items. Quality assessment was conducted by two researchers and results compared, in order to enhance inter-rater reliability. Risk of bias was assessed by examining the use of randomisation, target sample size, allocation concealment, level of attrition and appropriate data analysis as described in each of the published studies. Despite low quality rating scores, all studies were kept for inclusion in the review because of the paucity of studies in the area.

Data extraction

Extracted data included: title, author, year of publication, journal, country of origin, design (type of trial, blinding, control group), patient characteristics and sample size, description of intervention, outcome variables, drop-out rates, and effects of the intervention.

Data analysis

A meta-analysis was not undertaken due to the methodological differences between the studies.

RESULTS

Selection of studies

The searching of selected databases with the appropriate key terms resulted in a total of 5758 citations from which relevant studies were selected for the review. Of these, 5539 citations were deemed irrelevant based on the previously mentioned exclusion criteria. Duplicates were then removed, leaving 63 studies which were identified as potentially relevant based on their title or abstract. The full text of these 63 studies was then assessed to select those intervention studies in pregnant women that directly related to public health interventions to reduce alcohol consumption or improve knowledge. Fourteen of these full text articles were excluded as they were narrative reviews or research protocols. A further 31 of these studies used a clinical intervention (such as motivational interviewing, brief advice or counselling), of which 22 used pregnant samples and 9 included non-pregnant women. Ten studies remained utilising a public health intervention, three of which were in a sample of pregnant women, while the remaining seven involved samples of women of child-bearing age. Of these, two did not use knowledge or alcohol consumption as an outcome measure and were excluded from the current review. An additional study did not report the requisite statistics [32]; when contacted, no reply was received from the authors, therefore reducing the final number of studies to seven. The flow diagram in figure 1 provides information regarding the number of studies considered at each stage. Hand-searching of the reference list of all included studies revealed no additional studies that met the inclusion criteria.

Description of studies

Seven studies met the inclusion criteria and were included in the review [33-39]. Two of these were randomised controlled trials (RCTs), two used a repeated measures cross-sectional design, and three involved a retrospective cross-sectional cohort design. Two studies employed random allocation of participants and included a control group in order to thoroughly evaluate the success of the interventions. One of the studies was conducted in South Africa [35], while five were conducted in various locations around the United States

[33, 34, 36-38], and one was conducted in Canada [39]. The studies were published between 1994 and 2012. Table 1 describes the characteristics of the included studies. The studies comprised a total sample of 5149 women at baseline. All seven studies used knowledge as a primary outcome measure and four studies also used alcohol consumption as an outcome measure.

Interventions

All studies involved an educational intervention using a multimedia campaign, although there were major differences in the methods of each study. One of the RCTs utilised pre-natal text messages to increase maternal health outcomes, encourage self-efficacy in the health system, and enhance knowledge of health care choices [34]; and the other used television commercials, a 10 minute DVD, and a printed pamphlet all with the tagline "being a good mother starts early and lasts a lifetime" in an attempt to provide women with information on the effects of alcohol consumption during pregnancy [33]. The remaining studies made use of mass media campaigns comprising posters, pamphlets, radio ads, television commercials and other community advertising. Two interventions were targeted at minority groups in the US; one at Northern Plains American Indian communities [36] and the other using a narrowcasting marketing campaign aimed at African-American and Latino adolescent girls [38]. One study focused on exposure to multiple sources of public health messages, as well as government warnings on alcoholic beverage containers [37]. One study used a combination of mass media campaigns and national health promotion events in order to reduce the prevalence rate of FAS as well as improving knowledge and reducing alcohol consumption among pregnant women [35]. A Canadian study utilised a 30-second television announcement with a message on alcohol and pregnancy in order to increase awareness of the risks of drinking during pregnancy [39].

Primary outcome measures

The primary outcome of interest in all studies was level of knowledge. All studies included in the review measured knowledge in a different way. Katsukas and Graves (1994) assessed knowledge with the use of a single statement, "women should not drink alcoholic beverages during pregnancy because of the risk of birth defects" and asked to indicate whether this statement was true or false. Glik et al. (2001) assessed knowledge with four closed-ended questions about whether a pregnant woman could drink alcohol without harming the baby and whether it would harm the baby if she drank in the first few weeks, the last few weeks, or at any time during the pregnancy. The responses were coded as "yes" or "no". Lowe et al. (2010) measured knowledge with a four part question stating "Do you think drinking during pregnancy increases the chances of any of the following: miscarriage, mental retardation, behaviour problems, and birth defects?" The response options included "yes", "no", and "maybe/sometimes", with a sum of all responses providing a total knowledge score. In Chersich et al. (2012) knowledge about the harms of drinking in pregnancy were assessed with true or false statements including: "one drink in pregnancy harms a foetus", "five drinks on one occasion in pregnancy harms a foetus", and "five drinks every day in pregnancy harms a foetus". Similarly in Evans et al. (2012), participants were given the statement "drinking alcohol will harm the health of my developing baby" and asked to indicate their agreement on a five point scale (from strongly agree to strongly disagree). In Casiro et al. (1994) knowledge assessment consisted of five questions on the effects of alcohol during pregnancy with responses coded as "true" or "false". The Hanson et al. study (2012) used a self-report measure of knowledge, asking participants to indicate whether the media campaign had increased their knowledge about the effects of alcohol on unborn children.

Secondary outcome measures

Four studies investigated the effect of a public health intervention on self-reported alcohol consumption rates [34-37]. In Chersich et al. (2012) mothers of children with FAS reported

drinking a median of 14.9 units a week during pregnancy pre-intervention (IQR = 4.7–31.4), compared to mothers of children with FAS post-intervention reporting a median of 5.8 units a week (IQR = 3.0–13.2; $p = 0.04$). Evans et al. (2012) found that participants in the intervention Text4Baby group reduced their alcohol consumption from 4.3% at baseline to 0.0% at follow-up ($p = 0.31$), while the control group showed no change. Kaskutas & Graves (1994) found that a reduction in alcohol consumption among women of child-bearing age was significantly predicted by exposure to three sources of media messages (OR = 2.83, $p<0.0001$). One study of American Indian women found that 71.8% of women reported that the media campaign had decreased their alcohol consumption [36].

Effect of interventions

The majority of included studies reported significant improvements in some aspect of knowledge scores attributed to the public health intervention. The Canadian study [39] reported a significantly higher percentage of women surveyed after the public health campaign thought that alcohol in pregnancy can lead to mental abnormalities (86.5% vs 93%, $p<0.001$), physical abnormalities (86.9% vs 91.8%, $p <0.001$), and behavioural abnormalities (80.9% vs 89.3%, $p <0.001$). Furthermore, women post-intervention believed that when a pregnant woman has an alcohol drink, the alcohol will reach the baby (95.3% vs 97.4%, $p <0.02$). In Kaskutas & Graves (1994) multivariate logistic models found that knowledge scores were increased among participants under the age of 40 (OR = 1.94, $p<0.0001$); and that women were more likely than men to know about the risk of birth defects (OR = 1.72, $p<0.0001$). Glik et al. (2001) found that African-American girls had a greater increase in knowledge than Latino girls ($p < 0.001$), although both groups had high knowledge scores at baseline. Among South African women, knowledge increased for all statements from a mean of 53.3% correct answers before intervention up to 89.7% of correct answers post intervention ($p < 0.001$) [35]. Using self-report data, the study of Northern Plains American

Indians found that 93.3% of women of child-bearing age (n = 111) believed that the media campaign had increased their knowledge about the effects of alcohol on unborn children. The study using prenatal text messages [33] found that knowledge scores in the intervention group were significantly improved post-intervention (M = 4.6 vs M = 4.4, p<0.05) with lower scores indicating improvement, while knowledge scores in the control group remained unchanged (M = 4.6).

One study [34] at baseline reported 52.3% of participants strongly agreed with the statement "drinking alcohol will harm the health of my developing baby", while at follow up only 44.28% strongly agreed, suggesting the intervention did not have any effect on knowledge and beliefs. However, odds ratio analysis indicated a significant improvement in knowledge about alcohol consumption from baseline to follow up in those who had high school levels of education or greater (OR = 2.80, p = 0.026).

Quality of included studies

Based on the Moncrieff et al. [31] quality assessment instrument, the published studies received a score between 14 and 26 out of a possible 46. This indicates the included studies are not of a particularly high quality. Despite many of the studies achieving similar scores, the risk of bias associated with the included studies was varied. None of the studies provided adequate information on all methods used. Of the RCTs, only one explained how randomisation was achieved [34]. This was also the only study to provide a target sample size through power analysis. Neither of the RCTs discussed allocation concealment, although blinding participants and health professionals in an educational intervention is generally not achievable. Levels of attrition were reported in three studies, and were high (21-27%). Three

of the cross-sectional studies did not report whether participants were selected with effective randomisation tools; however, one study reported random digit dialling of telephone surveys [37], and the cohorts both before and after the intervention in South Africa were also effectively randomised [35]. Due to inadequate research design, many of the studies included in this review cannot conclusively state whether the intervention was responsible for knowledge increase among the population. Six of the included studies did not discuss the reliability or validity of the measurement tools used to assess knowledge; however, one study assessed alcohol use with a validated instrument [35]. Evans et al. (2012) gave a detailed description of the development of their questionnaire and the validation process. The data analysis techniques in all studies were appropriate for the research design and the limits of the chosen design and analyses were thoroughly discussed in most of the studies. Overall the included studies showed considerable differences in design, methodology, and reporting, and all demonstrated considerable risk of bias in certain capacities.

DISCUSSION

This critical literature review is the first to date evaluating the effectiveness of public health interventions to improve knowledge about alcohol use and reduce alcohol consumption among pregnant women, and women of child-bearing age. From 1994 to 2014, there have been seven research articles published in peer-reviewed journals that investigate the use of public health interventions to reduce alcohol consumption in pregnant women. An investigation of the effectiveness of these interventions was deemed important as the public health approach may be able to reach a wider audience than clinical interventions, and is often successful in general populations [28]. Clear, concise evidence of their effectiveness may result in an increased use of these interventions to educate pregnant women, and the

general public, regardless of levels of alcohol consumption. Moreover, there is the potential that the use of public health interventions could reduce financial and administrative costs to the health-care system.

All studies used random samples, mostly with low alcohol consumption rates, and all used educational, multimedia interventions. Two studies used a randomised controlled design; two used a repeated measures cross-sectional design; and three involved a retrospective cross-sectional cohort design, however, only one study acknowledged the limitations of this. Improvements in knowledge were reported in six studies, whereas one study found contradictory results. Furthermore, four of the studies in this review investigated the effectiveness of public health interventions on reducing alcohol consumption. These studies found that alcohol consumption was reduced among women post-intervention; however, these results were not significant.

Direct comparison of the effectiveness of the interventions across studies was difficult due to differences in methodology such as study design, intervention type, and outcome variables. Thus a meta-analysis was not possible. Further, the studies identified varied greatly in the measures that they used to determine the same outcomes. As one of the primary outcomes of interest was knowledge about the harms of consuming alcohol while pregnant, all studies measured this at follow-up. However, the method in which knowledge was examined ranged from: a single true/false statement [34, 37]; questions about the level of alcohol that can cause harm [35]; harms associated with the timing of exposure [38]; and questions on the effects of alcohol consumption [33, 39]. Additionally these self-report questions were measured with a two-point, three-point, or five-point scale. Therefore, although the majority of the reviewed studies showed improvements in knowledge post intervention, these results are incomparable. The only study that did not show improvement in knowledge among the intervention group employed a single knowledge statement regarding drinking alcohol during pregnancy and had

a small sample size (n = 96). As only four studies in this review reported alcohol consumption during pregnancy as an outcome variable, future research may need to investigate the effectiveness of public health interventions to reduce alcohol consumption by including this as an outcome measure. However, a large proportion of public health research focuses on improving levels of knowledge, and although this is very important, it does not necessarily lead to behaviour change. Therefore clinical interventions may be more suitable in order to reduce alcohol consumption in pregnant women, particularly those at high-risk, such as alcohol dependent women. In five of the included studies the alcohol consumption of the participants was not reported, and in the studies where alcohol consumption was reported women were not consuming at high risk levels. As there is little evidence of the negative effects of low levels of consumption the overall impact of the described campaigns in reducing harm is uncertain. As it is known that the risk of harm is greatest with high levels of alcohol consumption, interventions that target this population group are still required.

In terms of the efficacy of the trialled interventions, four studies reported significant improvements in knowledge of alcohol use in pregnancy, although the cross-sectional design means that this increase may not be due to the intervention itself, and it is also difficult to determine whether knowledge improved on an individual level [35, 37-39]. Importantly, all of these studies used media campaigns involving television commercials and posters. One other multimedia campaign also reported significant improvements in knowledge, and the use of a randomised controlled study design indicates that these results are more than likely due to the intervention itself [33]. One study did not show an improvement in knowledge post-intervention [34].

The inconsistency in the methods of measurement and analysis used in each, means that it is difficult to draw meaningful conclusions from the studies in this review. Moreover, the majority of the studies in this review were conducted in the United States, limiting the

generalizability of the results given differences in cultural drinking attitudes [9]. Overall there is limited support to suggest that public health interventions successfully reduce alcohol consumption rates among pregnant women, or increase knowledge about the harms of alcohol consumption in pregnancy. The risk of bias associated with all of the studies makes it difficult to assert that the increase in knowledge amongst the intervention groups is a direct result of the intervention. None of the studies was of high quality when using a quality assessment instrument [31]; therefore caution must be taken when drawing conclusions from this research.

Additionally, the extensive literature search resulted in only seven studies that met all inclusion criteria for this review, only three of which were conducted among populations of pregnant women. The scarcity of research in this area also makes it hard to draw conclusions about the effectiveness of public health interventions among pregnant women. A large majority of studies in this area focus on clinical interventions. Furthermore, public health campaigns targeted towards pregnant women may not concentrate on high risk women, so it is suggested that interventions specifically aimed at these groups are still required. However, this population group may be more responsive to a clinical intervention, which focuses on the individual, rather than a public health campaign which may not be as effective at changing behaviour.

Strengths and limitations of the review

This review followed the PRISMA statement in order to conform to the preferred reporting of a critical review[40]. Despite this, there are some limitations associated with the conduct of this review; including the search strategy limited to English language studies only. Further, the review may be affected by publication bias, in that studies which found insignificant results may not have been published.

Implications for future research and practice

The paucity of studies in this review reflects a lack of evaluation research to support the effectiveness of public health interventions in this area. The lack of research in this area is surprising, given large amounts of research having been conducted in similar fields using clinical interventions, focusing on alcohol dependent populations [26, 27, 41]. The results of this critical review emphasize the lack of evidence and highlight a need for further research on this topic.

Conclusion

The purpose of this review was to determine whether public health interventions can successfully increase knowledge about the effects of alcohol consumption in pregnancy, and reduce alcohol consumption in pregnant women. The conclusion is that there is little evidence about the effectiveness of public health interventions aimed at reducing alcohol consumption among pregnant women. There is an urgent need for more research to be conducted, particularly in countries other than the United States. Furthermore, this review highlights the need for existing public health interventions to be thoroughly evaluated.

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Figure 1: Flow chart of literature search

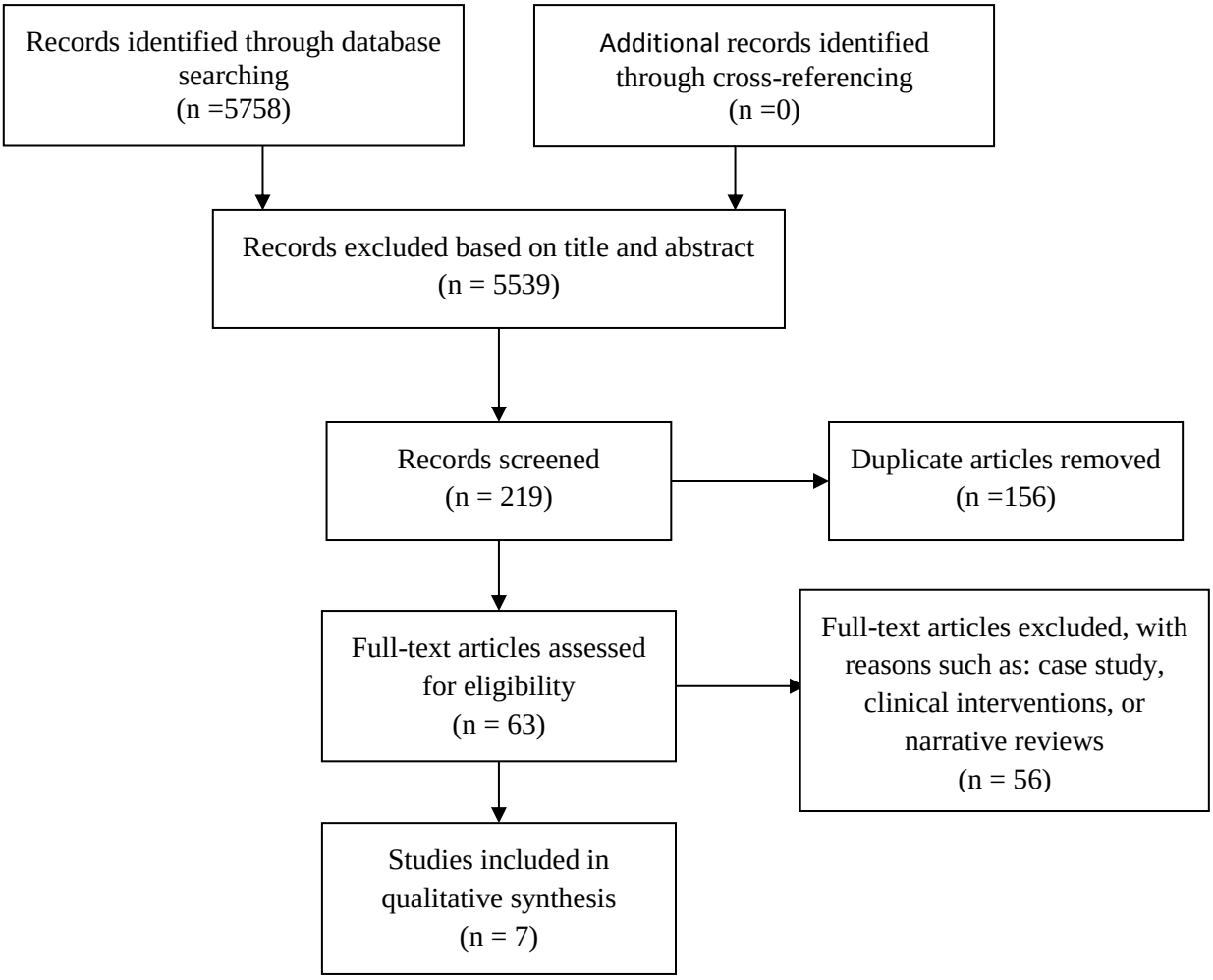


Table 1. Characteristics of included studies

Author, location and study design	Participant details	Intervention details	Outcome measures	Results	Quality rating
Casiro et al. (1994) Canada Repeated measures cross-sectional survey design.	N[a] = 2000 women of child-bearing age (age 15-45) attending GP and health clinics, age distribution similar in before and after campaign. Attrition: 26.7%	Public awareness campaign: 30-second television public service announcement (shown 585 times).	Knowledge of the risks of drinking alcohol during pregnancy, and sources of the information.	Increase in knowledge that drinking alcohol in pregnancy can lead to mental abnormalities in a baby (93%, p<0.001), physical abnormalities (91.8%, p<0.001), and behavioural abnormalities (89.3%, p<0.001).	20/46
Hanson, Winberg & Elliott (2012) USA Cross-sectional survey design with convenience sample	N[a] = 119 American Indian women of child-bearing age (18-44)	Universal prevention intervention: Posters, radio advertisements, brochures and pens.	Self-reported knowledge about FAS, self-reported alcohol consumption, and cultural appropriateness.	The media campaign was seen as culturally appropriate (85.7% agree). The majority of women felt the media campaign increased their knowledge about FAS (91.6% agree). Most women said the campaign decreased their drinking (71.8% agree).	14/46
Kaskutas & Graves (1994) USA Cross-sectional telephone interview design	Total sample N = 4017 (1130 women of child-bearing age, 18-40), 13% Black/Hispanic origin, 88% high school education or greater.	Health information campaign: Warnings on alcoholic beverage containers, warning poster in restaurants and bars, and media advertisements.	Knowledge of the alcohol-related risk of birth defects, conversations about drinking in pregnancy, and self-reported alcohol consumption.	930 women (82%) reported seeing messages. Participants exposed to messages were more likely to converse about drinking in pregnancy. A significant reduction in consumption was observed only in women who saw all 3 types of messages.	24/46
Glik, Halpert-Schilt & Zhang (2001) USA Repeated measures cross-sectional survey design	Wave one: N = 971 senior high school girls, mean age = 15.1 years, 46% Latina, 54% African American.	Narrowcasting social marketing campaign: Posters and cards with different slogans targeted towards African American and Latino populations.	Exposure to campaign, recall of messages delivered in campaign, and knowledge about harms of drinking in pregnancy.	Both African American and Latina girls reported exposure to the campaign (78%) and a significant amount recalled the message accurately (17%). Knowledge increased significantly among African American girls but not Latina.	23/46
Chersich et al. (2012) South Africa Cross-sectional cohort study	N[a] = 106 pregnant women, mean age = 27.4 years, 80% mixed ancestry, 72% single, 46% above primary education, 77% unemployed. Attrition: 39%	Universal prevention intervention: pamphlet and posters, newspaper articles focused on FASD prevention, radio and television advertisements, training at health clinics. No control group.	Maternal: alcohol use in pregnancy, knowledge about harms of drinking in pregnancy, exposure to FASD information. Infant: FAS diagnosis, dysmorphology, birth weight.	Maternal: Median drinks per week decreased from 12.1 to 8.5 post intervention (p=0.32); knowledge increased post intervention (from 53.3% correct answers to 89.7%, p<0.001); the intervention reached a large proportion of population (80%). Infant: FAS prevalence (p = 0.02) and dysmorphology (p = 0.002) both decreased	25/46

				after intervention; however, birth weight remained the same (p = 0.89).	
Evans et al. (2012) USA Randomised controlled trial	N[a] = 123 pregnant women, mean age = 27.6 years, 80% Hispanic origin, 70% single or unmarried, 58% completed high school education, 57% unemployed. Attrition: 27%	Prenatal text messages: text messages sent offering immediate tips to improve prenatal and postpartum health outcomes. Control group: no exposure to text messages, standard prenatal counselling and care.	Behavioural outcome measures and attitudes and belief outcomes.	Decrease in knowledge about alcohol's harms (p=0.288); non-significant decrease in consumption levels (p=0.314) with intervention group achieving higher levels of behaviour change.	26/46
Lowe et al. (2010) USA Randomised controlled trial	N[a] = 700 pregnant women, mean age = 24.2 years, 70% living with partner, 47% completed high school education. Attrition: 22%	Multimedia campaign: 30 second TV commercial, 10 minute DVD in antenatal clinics, printed pamphlet. Control group: TV commercial and usual care.	Recall of commercial, interaction with people in circle of influence about alcohol use, knowledge of the effects of alcohol on a developing foetus.	61.4% of women in intervention recalled seeing commercial compared with 48.5% of controls (p<0.001); 58.3% women in intervention talked about alcohol use with friends compared to 49.4% of controls (p=0.05); knowledge scores improved from means of 4.6 to 4.4 post intervention, with lower scores indicating improvement (p<0.05).	26/46