

REVIEW

Association between pregnancy intention and smoking or alcohol consumption in the preconception and pregnancy periods: A systematic review and meta-analysis

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Abstract

Aims: To investigate the association between pregnancy intention and smoking or alcohol consumption in preconception and pregnancy periods.

Background: Suboptimal lifestyle such as smoking and alcohol consumption can lead to devastating outcomes on the maternal and foetus. Pregnancy intention exerts a significant effect on promoting healthy lifestyle behaviours. However, no reliable evidences confirmed pregnancy intention was associated with smoking and alcohol consumption before and during pregnancy.

Design: Systematic review and meta-analysis.

Methods: We performed a comprehensive search from databases including PubMed, Cochrane, Web of Science, IEEE Xplore, MEDLINE, ProQuest and Scopus from the inception of these databases up to November, 2020. All eligible studies exploring the association between pregnancy intention and smoking or alcohol consumption were included. The fixed- or random effect pooled measure was used to estimate the odds ratio (OR) or risk ratio (RR) and 95% CI. In addition, the PRISMA checklist was used in this meta-analysis.

Results: A total of 23 studies were included in this systematic review and meta-analysis. During pregnancy, the findings suggested that women with unplanned pregnancy were 68% more likely to consume cigarettes (OR = 1.68, 95% CI = 1.44–1.95) and 44% more likely to consume alcohol (OR = 1.44, 95% CI = 1.15–1.81) than those women with planned pregnancy. Meanwhile, during preconception, women with unplanned pregnancy were 30% more likely to consume cigarettes (OR = 1.30, 95% CI = 1.10–1.53) and 20% more likely to consume alcohol (OR = 1.20, 95% CI = 1.01–1.42) than those women with planned pregnancy.

Conclusion: The findings suggested that women with unplanned pregnancy were more likely to follow unhealthy behaviours such as smoking and alcohol consumption before and during pregnancy. Health professionals should consider the women's desire for pregnancy to decrease preconception and pregnancy smoking or alcohol consumption in future studies.

Relevance of clinical practice: Pregnancy intention is the key determinant of smoking and alcohol consumption during preconception and pregnancy periods. Offering effective contraception in primary healthcare setting could prevent unplanned pregnancy. Meanwhile, popularising minimal alcohol consumption and comprehensive smoke-free legislation would be beneficial to improve reproductive outcomes.

KEYWORDS

alcohol consumption, health behaviours, meta-analysis, planned pregnancy, pregnancy intention, reproductive age, smoking

1 | INTRODUCTION

It is noted that preconception and pregnancy periods are the critical time to engage women in healthy lifestyle for improved maternal and foetal outcome (Hill, Kothe, et al., 2019). Suboptimal healthy behaviours such as smoking and alcohol consumption before and during pregnancy both bear serious harmful consequence, might due to the susceptibility in this specific period. For instance, inappropriate pregnancy alcohol consumption is broadly associated with increased risk of intellectual disability and neurological development deficiencies (Flak et al., 2014). Alcohol consumption at any stage of pregnancy all can exert a teratogenic effect on foetus (McDonald et al., 2014). As same, pregnancy smoking contributes to negative effect, including spontaneous pregnancy loss, low birth weight (LBW), placental abruption, gestational diabetes mellitus (Bar-Zeev et al., 2020) and stillbirth (Stewart & Streiner, 1995). Smoking cessation before or during pregnancy can broadly reduce the adverse outcomes (Office of the Surgeon General (US) & Office on Smoking and Health (US) (2004)). Importantly, even though numerous guidelines recommended the cessation of smoking and alcohol consumption, the rates were still in the high level (Smedberg et al., 2014; Svetlana et al., 2017). Therefore, optimising smoking and alcohol consumption in preconception and pregnancy periods are warrant for realising favourable health outcome.

It is well established that pregnancy intention is classified as three dimensions: unplanned, mistimed and planned. Pregnancy intention is an imperative concept implicated in preconception health (Johnson et al., 2006) and provides opportunity to explore motivation for early intervention. However, few women discussed their pregnancy intentions with healthcare providers (Tolossa et al., 2020). Some women were even not aware of pregnancy when they conceived. Thus, they hardly searched for information and made improved healthy behaviours (Lewis et al., 2013). As same, with the limitation of time, competing priorities and barriers confirming planned pregnancy, preconception counselling was underutilised by healthcare providers. Data indicated that 44% pregnant women were unplanned pregnancy globally, half in United States (ACOG, 2016b) and 70% in Australian (Lang et al., 2020). Women with intended pregnancy were more likely to take optimal lifestyle and attended antenatal care regularly (Lundsberg et al., 2018). Consequently, promoting planned

What does this paper contribute to the wider global clinical community?

- Women with unplanned pregnancy are more likely to consume cigarettes and alcohol in the preconception and pregnancy periods.
- Integrating family planning and effective contraception in primary healthcare settings might prevent unplanned pregnancy.
- Increased efforts should be made to popularise minimal alcohol consumption and comprehensive smoke-free legislation to reduce risk behaviours among women in reproductive age.

pregnancy could achieve the first-grade prevention to decrease smoking and alcohol consumption.

Prior systematic review and meta-analysis had investigated the association between pregnancy intention and diet, physical activity (Nkrumah et al., 2020), perinatal depression (Abajobir et al., 2016) and late initiation of antenatal care (Tolossa et al., 2020). One recent systematic mapping review investigated pregnancy intention and health-related lifestyles or psychological variables and recommended to comprehensively synthesize literatures of smoking and alcohol consumption among unplanned pregnancy (Hill, Kothe, et al., 2019). Indeed, several primary studies had sought to determine whether unplanned pregnancy increased the odds of smoking and alcohol consumption either before or during pregnancy, but the findings were inconsistent. Accordingly, the current meta-analysis aimed to explore pregnancy intention and its association with preconception and pregnancy smoking and alcohol consumption to inform further early prevention and targeted intervention for women.

2 | AIM AND METHODS

The systematic review and meta-analysis aimed to investigate the association between pregnancy intention and smoking or alcohol consumption in preconception and pregnancy periods.

2.1 | Search strategy

This literature was performed according to the Preferred Reporting Items and Meta-Analysis (PRISMA) checklist (Moher et al., 2009) (supplementary file 1) and was prospectively registered on the PROSPERO (registration number CRD42020219002). We searched relevant articles in the following databases including PubMed, Cochrane, Web of Science, IEEE Xplore, MEDLINE, ProQuest and Scopus from the inception of these databases up to November 2020. The search terms contained: (fertility intention OR pregnancy intention OR unplanned pregnancy OR unintended pregnancy OR unwanted pregnancy) AND (preconception lifestyle OR prenatal OR perinatal OR antenatal OR smoking OR alcohol). Reference list of all selected articles were independently screened to identify studies left out in the initial search.

2.2 | Study selection

We selected all eligible studies based on PECOS approach (participants, exposure, comparison, outcome, study design). Type of participants: all preconception, pregnant and postpartum women. Type of exposure: unplanned pregnancy. Type of comparison: planned pregnancy. Type of outcome: smoking or alcohol consumption before or during pregnancy. Type of study design: all observational studies, for example cross-sectional, case-control and longitudinal studies. We excluded part of the descriptive research, for example quantitative studies, study protocol and case study. Meanwhile, unpublished or grey literature, studies without abstract or full text were also excluded. Only papers published in English were included due to the limitation of translating non-English articles.

2.3 | Data extraction

Data were strictly extracted and proofread according to the aforementioned inclusion and exclusion criteria. Parameters regarding study author, year, country; study design; sample size; measures of pregnancy intention and outcomes; confounders; multivariate adjusted risk ratio (RR) or odds ratio (OR) with 95% CIs relevant to the study were independently extracted by two investigators with consulting a third reviewer when we were caught in a dilemma.

2.4 | Methodological quality of studies

The Joanna Briggs Institute (JBI) critical appraisal checklist (JBI, 2019) with 8 items was used to evaluate the quality of cross-sectional studies and the nine-star Newcastle-Ottawa Scale (Stang, 2010) with 3 dimensions was used to evaluate the quality of case-control and cohort studies respectively. Similarly, discrepancies were resolved by discussion. We did not exclude any study in this phase.

2.5 | Data synthesis

Pooled measure was calculated as the inverse variance-weighted mean of the natural logarithm of multivariate adjusted OR/RR with 95% CIs to assess the association between pregnancy intention and smoking or alcohol consumption. The I^2 statistic was used to assess the heterogeneity of included studies, with I^2 values of 0, 25, 50 and 75% were considered to be no, low, moderate and high evidence of heterogeneity (Higgins et al., 2003). The random effect model (REM) was adopted as the pooling methods in the presence of substantial heterogeneity ($I^2 > 50\%$), otherwise the fixed effect model (FEM) was adopted as the pooled methods. Also, a sensitivity analysis was performed to identify the key studies with substantial impact on between-study heterogeneity. We used the Egger's weighted regression test to check publication bias (Egger et al., 1997).

All eligible articles reporting homogeneous outcomes were included in the meta-analysis. In this study, we only included studies comparing smoking and alcohol consumption among women with unplanned pregnancy and planned pregnancy: unplanned (pregnant women did not want to be pregnant now or in the future) and planned (pregnant women thought pregnancy occurred as they expected). The overall meta-analysis about behaviours was conducted separately for preconception and pregnancy behaviours.

3 | RESULTS

3.1 | Study selection

Using the preferred reporting items for systematic reviews and meta-analyses (PRISMA) flow diagram, the procedures and reason for including studies were presented in Figure 1. 1864 articles were identified by using search engines and strategies. After removing duplicates and screening abstracts and titles, 131 full-text papers were included. The reasons for excluded studies at a full-text stage were listed in Figure 1. Finally, 23 studies were included in the meta-analyses.

3.2 | Characteristics of included studies

Detailed information on the included studies was showed in Table 1. A total of 23 studies were included and the sample size ranged from 317 to 72182. Of these studies, 9 were cross-sectional studies, 13 were cohort studies and only 1 study was case-control design. Besides, 10 studies were conducted in USA, 4 in Canada, 2 in Australian, Japan and Korea and 1 in Southern Ethiopia, Netherlands and Singaporeans.

In total, most articles assessed pregnancy intention by using simple questionnaire. The common survey questions were: 'thinking about the current pregnancy, how did you feel about being pregnant?' and the answer were often categorised as two (unplanned and planned) or three (unplanned, mistimed and planned) varies. Only one article assessed pregnancy intention by using LMUP (London Measure of Unplanned pregnancy), in which score ≥ 10 was classified as planned and 0–9 was classified as unplanned.

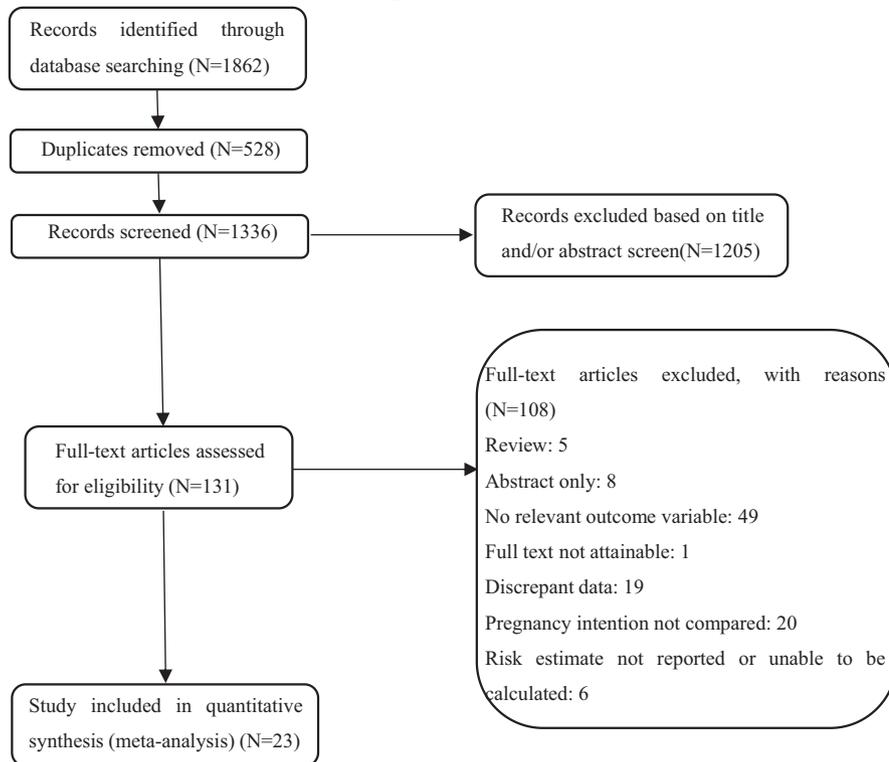


FIGURE 1 Flow diagram of study selection

Similarly, almost all studies assessed smoking and alcohol consumption by asking whether or not they smoked/drank 3 months before pregnancy or during pregnancy. Only two studies assessed alcohol consumption by using AUDIT-C (Alcohol Use Disorder Identification Test-C). These common covariates contained demographic data, psychological factors and other lifestyle behaviours. All articles reported adjusted ORs except for one article showed RR estimates. Furthermore, 9 studies reported smoking and alcohol consumption both before and during pregnancy, the remaining studies only reported either before or during pregnancy.

3.3 | Quality assessment

The results of methodological quality were showed in Supplementary file 2. None cross-sectional studies fulfilled all of the eight criteria in JBI critical appraisal checklist, in which the values ranged from 5 to 7. The two most common risks of bias among included studies were the measures of exposures and outcomes. Furthermore, of 14 literatures evaluated by using Newcastle-Ottawa Scale, all case-control and cohort studies were evaluated as high quality (the value range from 7 to 9). However, more than half of the studies seemed to selectively report the reason for drop-out.

3.4 | Pregnancy intention and smoking consumption during pregnancy

During pregnancy, 13 studies with 14 results (Altfeld et al., 1997; Baron et al., 2013; Cheng et al., 2009; Dott et al., 2010; Erol

et al., 2010; Han et al., 2005; Hellerstedt et al., 1998; Lindberg et al., 2015; Mekuriaw et al., 2019; Orr et al., 2008; Smedberg et al., 2014; Stewart & Streiner, 1995; Suzuki et al., 2010) reported the association between pregnancy intention and smoking consumption, as delineated in Figure 2. The summary OR (95% CI) of smoking consumption among unplanned pregnancy compared with planned pregnancy was 1.68 (1.44–1.95) and substantial between-study heterogeneity was found ($p_{\text{heterogeneity}} = 0.002$, $I^2 = 59.90\%$).

After removing the study (Lindberg et al., 2015) vastly affecting heterogeneity, the pooled OR (95% CI) was 1.75 (1.53–2.00) with moderate heterogeneity between the studies ($p_{\text{heterogeneity}} = 0.046$, $I^2 = 43.77\%$). The Egger's test showed no evidence of significant publication bias ($p = 0.767$) in the above-mentioned analyses.

3.5 | Pregnancy intention and alcohol consumption during pregnancy

Similarly, 11 studies (Altfeld et al., 1997; Cheng et al., 2009, 2016; Dott et al., 2010; Han et al., 2005; Hellerstedt et al., 1998; Lee et al., 2010; McDonald et al., 2014; Orr et al., 2008; Pryor et al., 2017; Stewart & Streiner, 1994) explored the alcohol consumption among women with unplanned pregnancy, as demonstrated in Figure 2. The findings suggested that women with unplanned pregnancy were 44% more likely to report alcohol consumption (OR = 1.44; 95% CI = 1.15–1.81) and substantial between-study heterogeneity was found ($p_{\text{heterogeneity}} < 0.001$, $I^2 = 79.60\%$).

After excluding two studies (Cheng et al., 2009; Dott et al., 2010) exerting vital effect on heterogeneity, the pooled OR (95% CI)

TABLE 1 Characteristics of included studies

ID	Author, year, country	Study design	Sample size (N)	Measure of exposure	Measure of outcome	Confounders	ORs (95% CIs)
1	Stewart and Streiner, 1994, Canadian	Cross-sectional	466	Self-made questionnaire	Alcohol: Self-reported about the current regular weekly average intake of alcohol in ounces by beverage	Age, education, employment, married, emotional problems, healthy diets, smoke, use illicit drugs, and physically abuse	Alcohol: 1.58(1.21–2.06)
2	Stewart and Streiner, 1995, Canadian	Cross-sectional	545	Self-made questionnaire	Smoking: Self-reported about whether smoke and the amount of cigarettes per day	Education, employment, married, healthy diets, alcohol, illicit drugs, histories of emotional and physical problems and physical abuse	Smoking: 2.25(1.81–2.79)
3	Altfeld et al., 1997, Chicago	Cross-sectional	378	Self-made questionnaire	Smoking: Self-reported: How many cigarettes per day Alcohol: Self-reported: How much alcohol they drank per week	Age, race/ethnicity, total annual household income, education, marital status, number of living children including newborn, source of payment for prenatal care	Smoking: 0.30(0.15–0.9) Alcohol: 0.46(0.26–0.82)
4	Hellerstedt et al., 1998, United States	Cohort study	7174	Self-made questionnaire	Alcohol: Self-reported: How much alcohol they drank per week Smoking: Self-reported: Smoker or non-smoker	Gestational age of the foetus, maternal age, race, marital status, education, income, employment status and study site	Pregnancy: Smoking: 1.54(1.27–1.88) Alcohol: 1.17(0.77–1.76) Preconception: Smoking: 1.50(1.28–1.75) Alcohol: 1.15(1.02–1.29)
5	Naimi et al., 2003, United States	Case-control	72907	Self-made questionnaire	Alcohol: Self-reported: How many times they binge drank 1 occasion Smoking: Self-reported: the amount of cigarettes daily	Age, education, marital status, parity, birth control use at conception, health insurance status, receipt of Medicaid, binge drinking, smoking and exposure to physical violence	Preconception(white): Smoking: 1.46(1.34–1.59) Alcohol: 1.63(1.47–1.80) Preconception(black): Smoking: 0.95(0.78–1.16) Alcohol: 0.96(0.77–1.20)
6	Han et al., 2005, Korea	Cross-sectional	1354	Self-made questionnaire	Smoking/alcohol: Self-made questionnaire	Age, history of pregnancy and abortion, education, income	Smoking: 1.5(1.0–2.3) Alcohol: 1.9(1.5–2.5)
7	Orr et al., 2008, Baltimore, Maryland	Cohort study	913	Self-made questionnaire is similar to NSFG	Smoking/alcohol: Simple enquiry	Age, education, marital status, initiation of prenatal care	Smoking: 1.96(1.11–3.45) Alcohol: 1.54(0.75–3.13)
8	Cheng et al., 2009, Maryland	Cohort study	9048	Self-made questionnaire	Smoking/alcohol: Self-made questionnaire	Race, age, education, Medicaid enrolment, marital status, previous live births	Smoking: 2.07(1.47–2.92) Alcohol: 0.76(0.51–1.13)

(Continues)

TABLE 1 (Continued)

ID	Author, year, country	Study design	Sample size (N)	Measure of exposure	Measure of outcome	Confounders	ORs (95% CIs)
9	Dott et al., 2010, United States	Cross-sectional	4094	Simple enquiry about the use of contraception.	Smoking/alcohol: Simple enquiry	maternal age, maternal education, race, annual family income and previous adverse pregnancy outcome	Pregnancy: Smoking: 1.99(1.55–2.54) Alcohol: 0.77(0.59–1.00) Preconception: Smoking: 2.00(1.63–2.45) Alcohol: 0.88(0.74–1.05)
10	Erol et al., 2010, Turkey	Cross-sectional	351	Simple enquiry with the definition is similar to those of the Turkish DHS.	Smoking: Not explicitly mentioned	Ages, occupation, education, place of birth, marital status, social security status, income level, fertility history, prenatal care and health status	Smoking: 1.88(0.33–10.89)
11	Lee et al., 2010, Korea	Cohort study	646	Self-administered questionnaire	Alcohol: Alcohol Use Disorder Identification Test (AUDIT)-C	Age, educational level, the weeks of pregnancy, history of pregnancy or miscarriage, occupation and annual family income level	Alcohol: 0.418(0.273–0.641)
12	Suzuki et al., 2010, Japan	Cohort study	1996–2001: 1051 2001–2006: 100	Self-reported questionnaire	Smoking: Self-reported questionnaire	Age, number of pregnancies, family make-up, occupational status, breakfast habits, gestational age and smoking habits of the partner	Smoking: OR = 1.44(0.86–2.42) OR = 1.78(1.07–2.97)
13	Baron et al., 2013, Netherlands	Cohort study	6107	Self-made questionnaire	Smoking: Simple enquiry about whether smoked daily, occasionally or not at all	Age, education, SES, ethnicity, relationship status, religion, the number of children, BMI, depressed/anxious mood and health control belief	Smoking: 1.4(1.1–1.8)
14	McDonald et al., 2014, Canadian	Cohort Study	2246	Simple enquiry	Alcohol: Self-reported questionnaire on frequency (days per week) and amount (drinks per occasion)	Socio-demographics, mental health problems, history of abuse, lifestyle, BMI, parity, prenatal depression, anxiety, social support, maternal optimism, psychosocial health and optimism	Alcohol: 1.91(1.45–2.52)
15	Smedberg et al., 2014, 15 European countries	Cross-sectional	8344/2944	Self-made questionnaire	Smoking: The amount of cigarettes (on average) per day	Age, marital status, education level, working status, first language, previous children, health literacy and folic acid use	Pregnancy: Smoking: 1.31(1.00–1.72) Preconception: Smoking: 1.32(1.11–1.56)
16	Lindberg et al., 2015, Oklahoma	Cohort study	8846	All state-level PRAMS surveys include a question on pregnancy intentions	Smoking: All state-level PRAMS surveys: The amount per day	Age, first birth, SES, marital status, race, education and health orientation and access	Smoking: 0.92(0.64–1.32)

(Continues)

TABLE 1 (Continued)

ID	Author, year, country	Study design	Sample size (N)	Measure of exposure	Measure of outcome	Confounders	ORs (95% CIs)
17	Cheng et al., 2016, Singaporeans	Cohort study	861	Self-made questionnaire including two questions.	Smoking: Self-made questionnaire	educational level, marital status, household monthly income, parity, age, weight and past medical history of type 2 diabetes and/or hypertension	Pregnancy: Smoking: 0 Alcohol: 1.294(0.158–10.584) Preconception: Smoking: 0.729(0.217–2.451) Alcohol: 1.069(0.571–2.002)
18	McCormack et al., 2017, Canadian	Cohort Study	1403	Simple enquiry with four answers.	Alcohol: Simple enquiry of frequency of alcohol use during each time period	Household socio-economic status, age, parity, BMI, education, marital status, smoking, country of birth and alcohol use pre-awareness	Alcohol: 1.553(1.141–2.114)
19	Pryor et al., 2017, USA	Cohort study	5036	Simple enquiry using the items developed by the CDC.	Alcohol: Simple enquiry about pattern, frequency, quantity and type of alcohol	Age, education, race, income, marital status, parity, BMI, the history of abortions	Alcohol: 0.69(0.60–0.81)
20	Lundsberg et al., 2018, western Massachusetts	Cohort study	2654	Simple enquiry	Alcohol/smoking: Simple enquiry about the amount per day/the amount per occasion	Age, race, ethnicity, education, relationship, parity, medical history, reproductive history, psychiatric status and substance use disorders	Smoking: 1.14(0.88–1.49) Alcohol: 1.06(0.85–1.32)
21	Hill, Kothe, et al., 2019, Australian	Cohort study	Wave 3:7656 Wave 5:4735	Simple enquiry about the use of contraception and the reason.	Smoking: Simple enquiry with two outcomes (non-smoker and current smoker) Alcohol: Simple enquiry	Age, education, psychological factors, marital status, employment, income, number of children, BMI, physical activity	Wave 3: Smoking: 1.2(0.9–1.5) Alcohol: 0.7(0.4–1.0) Wave 5: Smoking: 0.7(0.5–1.0) Alcohol: 0.8(0.5–1.2)
22	Mekuriaw et al., 2019, Southern, Ethiopia	Cross-sectional	718	Not explicitly mentioned	Alcohol: Alcohol Use Disorder Identification Test-C (AUDIT-C)	Age, education, marital status, religion, ethnicity, residency, occupation and income	Alcohol: 2.12(1.20–3.73)
23	Lang et al., 2020, Australian	Cross-sectional	317	LMUP	Smoking/alcohol: Simple enquiry	Age, relationship, place of birth, previous live birth, education, employment, medicine use	Smoking: 0.44(0.14–1.35) Alcohol: 0.34(0.16–0.70)

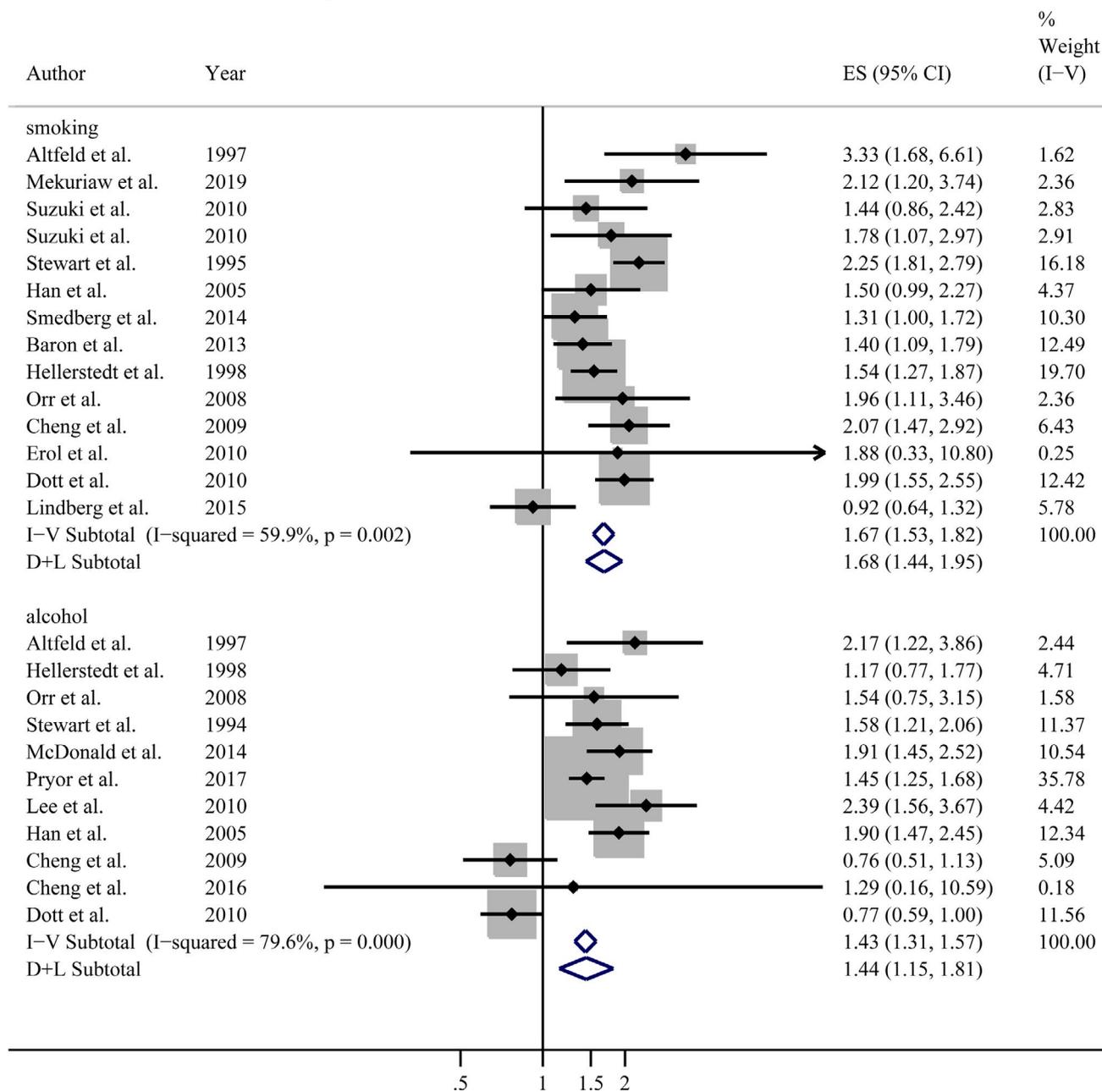


FIGURE 2 Forest plots showing estimates of the relationships between pregnancy intention and pregnancy behaviours

was 1.67 (1.46–1.92) with low heterogeneity between the studies ($p_{\text{heterogeneity}} = 0.167, I^2 = 31.46\%$). No evidence of publication bias ($p = 0.952$) was observed in the above-mentioned analyses before and after sensitivity analysis.

3.6 | Pregnancy intention and the smoking consumption during preconception

During preconception, 8 studies with 10 results (Cheng et al., 2016; Dott et al., 2010; Hellerstedt et al., 1998; Hill, Ling, et al., 2019; Lang et al., 2020; Lundsberg et al., 2018; Naimi et al., 2003; Smedberg

et al., 2014) investigated the association between pregnancy intention and smoking consumption, as demonstrated in Figure 3. The summary OR (95% CI) of smoking consumption among unplanned pregnancy compared with the reference category was 1.30 (1.10–1.53) and substantial between-study heterogeneity was found ($p_{\text{heterogeneity}} < 0.001, I^2 = 81.30\%$).

After removing three studies (Dott et al., 2010; Hill, Ling, et al., 2019; Naimi et al., 2003) greatly affecting heterogeneity, the pooled OR (95% CI) was 1.42 (1.33–1.52) with low heterogeneity between the studies ($p_{\text{heterogeneity}} = 0.414, I^2 = 1.34\%$). The Egger's test showed no evidence of publication bias ($p = 0.451$) in the above-mentioned analyses.

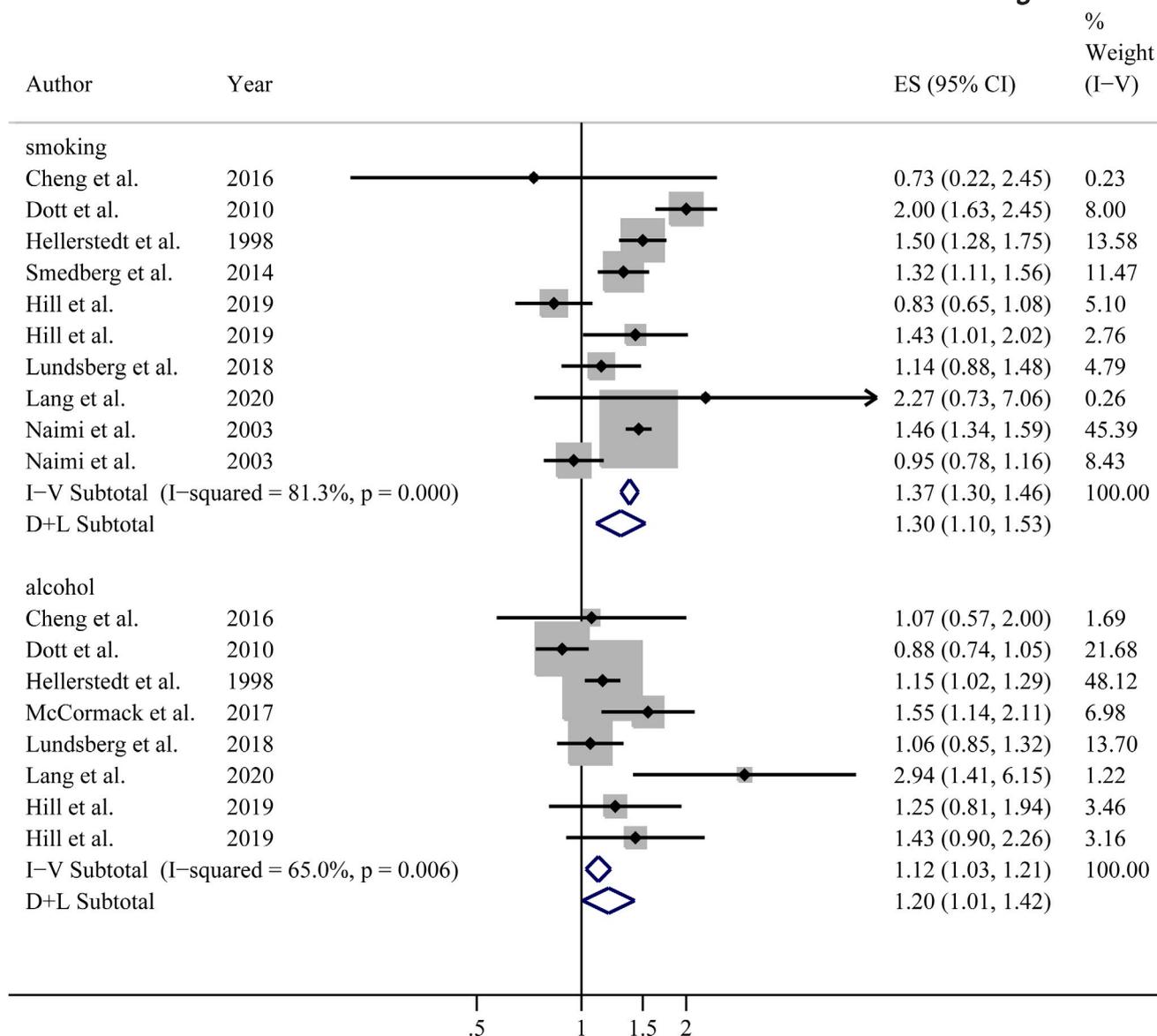


FIGURE 3 Forest plots showing estimates of the relationships between pregnancy intention and preconception behaviours

3.7 | Pregnancy intention and the alcohol consumption during preconception

As same, 7 studies (Cheng et al., 2016; Dott et al., 2010; Hellerstedt et al., 1998; Hill, Ling, et al., 2019; Lang et al., 2020; Lundsberg et al., 2018; McCormack et al., 2017) with 8 results examined the alcohol consumption among women with unplanned pregnancy, as delineated in Figure 3. The findings suggested that women with unplanned pregnancy were more likely to report alcohol consumption (OR = 1.20; 95% CI = 1.01–1.42) and substantial between-study heterogeneity was found ($p_{\text{heterogeneity}} = 0.006$, $I^2 = 65.0\%$).

After excluding one study (Dott et al., 2010) exerting substantial effect on heterogeneity, the pooled OR (95% CI) was 1.27 (1.08–1.49) with moderate heterogeneity between the studies ($p_{\text{heterogeneity}} = 0.095$, $I^2 = 44.42\%$). No evidence of publication bias ($p = 0.202$) was observed in the above-mentioned analyses.

4 | DISCUSSION

The current systematic review and meta-analysis suggested that women with unplanned pregnancy reported more smoking or alcohol consumption than women with planned pregnancy in preconception and pregnancy periods. Based on these findings, increased efforts should be made to reduce unplanned pregnancy for improved healthy lifestyle behaviours.

During the pregnancy period, the findings indicated that women with unplanned pregnancy were more likely to consume cigarettes and alcohol. This was particularly because that unplanned pregnancy was associated with delayed pregnancy recognition, late initiation of antenatal care (Tolossa et al., 2020) and poor knowledge regarding these unhealthy behaviours (Mullan et al., 2016). Thus, health education related to regular antenatal care and adverse outcomes of smoking or alcohol consumption during pregnancy should

be promoted especially for those women with unplanned pregnancy. Meanwhile, interventions should commence as early as possible in order to give sufficient time to improve unhealthy lifestyle behaviours before missing the window of motivation to modify (Dott et al., 2010). Furthermore, promoting the support of family should be treated as a key point to modify unhealthy lifestyle behaviours of unplanned pregnant women (Gross et al., 2012) due to the high level of perceived self-efficacy.

During the preconception period, defined as the 3 months before conception, women with planned pregnancy reported less consumption of cigarettes and alcohol, which especially because of early participation in preconception counselling (Williams et al., 2012). In general, preconception counselling contains health education and promotion, risk assessment and intervention (Fowler et al., 2021). Medical workers should advocate preconception cessation of smoking and alcohol consumption among women with planned pregnancy. All women should be screened for smoking and alcohol consumption during preconception counselling (Denny et al., 2017). Moreover, integrating family planning and effective contraception in primary healthcare settings could be beneficial to prevent unplanned pregnancy. It is suggested that the accessibility or side effect of contraception, the feeling of embarrassment and the influence of partner could all pose threat to effective contraception (Pratt et al., 2014), which should also be taken into consideration.

Public health organisations had treated reducing unplanned pregnancy as key goals (United Nations, 2015; WHO, 2020). Previous studies pointed out that recognising socio-economic factors consistent with unplanned pregnancy might help identify women requiring targeted intervention (Goossens et al., 2016; Lang et al., 2020). Notably, more women in reproductive age were adopting unhealthy lifestyle in recent years. Thus, popularising minimal alcohol consumption (Stephenson et al., 2018) and ascertaining a comprehensive smoke-free legislation (Hone et al., 2020) in all public indoor spaces should be highlighted to improve reproductive outcomes. Furthermore, reproductive life plan provided a novel approach to issue of unplanned pregnancy. It empowered women and their spouse to articulate their reproductive desires about whether or when to have children. Thus, health care providers could collaborate to achieve them (Morse & Moos, 2018). Despite many challenges remained regarding implementation, equity and outcomes, American College of Obstetricians and Gynecologists (ACOG) still recommended that every woman in reproductive age should have a reproductive life plan (ACOG, 2016a).

5 | STRENGTH AND LIMITATIONS

Although this review comprehensively synthesised literatures of smoking and alcohol consumption and pregnancy intention before and during pregnancy, there still existed several limitations. First, heterogeneities of this meta-analysis were in high level so the findings should be discussed cautiously. Second, the measurements of pregnancy intention and smoking or alcohol consumption were

inconsistent. Only three studies measured by using valid and reliable questionnaires such as LMUP and Test-C. Third, there existed recall biases among literatures using a retrospective design. Fourth, more details about the timing of planned pregnancy, the intensity and duration of smoking or alcohol consumption should be considered in future studies.

6 | CONCLUSION

The review demonstrated that women with unplanned pregnancy were more likely to consume cigarettes and alcohol before and during pregnancy. As such, preconception counselling and antenatal care should pay more attention to identify pregnancy intention and strengthen health lifestyle behaviours. Future research designs are needed to explore effective prevention and intervention to reduce unplanned pregnancy.

7 | RELEVANCE OF CLINICAL PRACTICE

The findings of this review highlighted the importance of preventing unplanned pregnancy to decrease smoking and alcohol consumption before and during pregnancy. Consequently, health education on family planning and effective contraception is imperative. The cost-effective public health actions such as popularising minimal alcohol consumption and comprehensive smoke-free legislation in the whole population are also advisable to reduce unhealthy behaviours. Importantly, reproductive life plan provided by healthcare providers could be treated as a novel approach to address the issue of unplanned pregnancy.

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None.

CONFLICT OF INTEREST

None.

AUTHOR CONTRIBUTIONS

Pengli Yu conceived the study design; Pengli Yu, Lixue Zhou, Yanhong Xu, Fei Meng and Kuinan Li searched and selected the articles, extracted, analysed and interpreted the data; Pengli Yu, Yunping Zhou and Yunxia Jiang drafted the manuscript. All authors read and approved the final version of the manuscript. The authors had no conflicts of interest.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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