Supplementary Material 3

Intervention Models and Behaviour Change Techniques to reduce the risk of Alcohol Exposed Pregnancies: A systematic review of interventions for non-pregnant women

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Table 1. Intervention Models, Target Behaviours and Outcomes

Study Underpinning theory	**Target behaviours**	**Intervention Model and Intervention**	**Control**	**Alcohol and Contraception Outcomes**	**Key Findings**
Walker et al., 2005 No underpinning theory was stated	Alcohol abstinence during pregnancy	Model: Alcohol-only educational Intervention: Educational assessment without feedback and a brochure about FASD	None	Knowledge about alcohol and FASD	A significant increase in mean test score on the alcohol knowledge questionnaire from 5.8 (SD-1.55) pre-intervention to 6.7 (SD-1.25) post-intervention ($p < .0001$)
Reynolds, Cook and McCarthy, 2021 No underpinning theory was stated	Alcohol abstinence during pregnancy Alcohol abstinence when planning a pregnancy	Model: Alcohol-only educational Intervention: Exposure to Drymester digital campaign communicating the risks of alcohol intake during pregnancy and the impact of FASD	People who could not recall seeing the Drymester campaign	Attitudes and knowledge of guidelines on alcohol use in pregnancy and when planning pregnancy	Attitudes differed between those who had seen the campaign and those who had not. Majority (80%) of those who saw the campaign disagreed that it was 'OK to drink as you normally would until you get a positive pregnancy test result' while 53% of those who had not seen the campaign disagreed with this (27% difference); 62% of those who saw the campaign disagreed with the statement "If you are trying to get pregnant, you should probably cut down but it is still OK to drink some" while only 39% of those who had not seen the campaign disagreed with this (23% difference)

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Delrahim-Howlett et al., 2011 Transtheoretical model	Low risk drinking: Drink less than 3 standard drinks on one occasion	Model: Single session alcohol-only SBI Intervention: Adaptation of e-CHUG: web-based alcohol use assessment and personalised feedback.	Information on effects of alcohol and risks of alcohol use during pregnancy	Risky Drinking Occasions (RDO) Mean Drinks Per Occasion (MDPO)	Decrease in RDO for both intervention (72%) and control groups (68%) OR = 1.20; $p = 0.634$).
Montag et al., 2015 No underpinning theory stated	Low risk drinking: Drink less than 8 standard drinks in a week, drink less than 4 standard drinks at one go	Model: Single session alcohol-only SBI Intervention: Adapted e-CHECKUP TO GO with assessment: A single web-based session of approx. 20 mins and personalised feedback	Assessment with treatment as usual	AEP Risk[a] (at high risk or not at high risk) Drinks per week Binge episodes per 2 weeks	Both groups decreased self-reported risky drinking (drinks per week, $p < 0.001$; frequency of binge drinking episodes per 2 weeks, $p = 0.017$) and risk of AEP ($p < 0.001$) at 6 months postintervention. The proportion at high risk of AEP reduced from about 35% at baseline to less than 25% in both intervention and control by 6 months. Binge episodes per two weeks reduced from about 1.2 at baseline to 0.4 at 6 months in the intervention group and from about 0.9 at baseline to 0.6 at 6 months in the control group. No significant difference in outcomes between intervention and control groups.

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Manwell et al., 2000 USA No underpinning theory was stated	Lower risk drinking: Desist from excessive drinking (Drink less than 13 drinks in a week), drink less than 4 drinks at one go	Model: Multi-session alcohol-only SBI Intervention: Project TrEAT: Two 15-minute physician sessions 1 month apart, supportive phone call from a nurse 2 weeks after each visit + workbook with personalised feedback.	Booklet with information on general health issues + instructions to address health concerns in usual manner	Alcohol consumption (number of drinks in previous 7 days, excessive drinking, binge drinking) Healthcare utilisation: Hospital days, ED visits Health status: smoking, depression, accidents	Significant decrease in 7-day alcohol use for intervention (M= 7.48 drinks) compared to control group (M = 9.94); p = 0.0039. Significant decrease in the number of binge episodes in the previous 30 days in the intervention (M = 2.95) compared to the control group (M = 4.51); p =0.0021. No significant difference in healthcare utilisation or health status between groups.
Nayak et al., 2019 Uses MI principles but no underpinning theory was stated	Low risk drinking: Drink less than 8 standard drinks in a week, drink less than 3 standard drinks in a day	Model: Multi-session alcohol-only SBI Intervention: DrinkWise, Screening and Brief intervention + drink size assessment, personalised drink size feedback, goal setting	Only drink size assessment at follow-up	Alcohol consumption: risky drinking, weekly alcohol use, heavy drinking (5 or more drinks in a day), Drink size	The intervention group had a greater reduction in the odds of self-reported weekly alcohol use (OR=0.22, p<0.05). The intervention group had a greater reduction in self-reported heavy alcohol use at 6 months compared to baseline (OR= 0.23, p<0.05) Significant decrease in drink size of heavy drinkers in the intervention group from 3 to 6 months compared to the control (Coeff= −0.82, p=0.06)

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Ceperich and Ingersoll, 2011 Transtheoretical model	Low risk drinking: Drink less than 8 standard drinks in a week, less than 5 standard drinks at one occasion. Effective contraception use at every sexual intercourse	Model: Single-session dual-focused, Intervention: BALANCE, 60–75-minute face-to-face MI session, personalised feedback	Pamphlet with information on women's health	AEP risk[a] alcohol use and contraceptive use	Significant decrease in AEP risk in the intervention (79.8% no longer at risk) vs. control (65.1% no longer at risk); $p < 0.02$.
Ingersoll et al., 2013 USA Transtheoretical model	Low risk drinking: Drink less than 8 standard drinks in a week, drink less than 4 standard drinks at one occasion Effective contraception use at every sexual encounter	Model: Single-session dual-focused, Intervention: EARLY, a single 60-min face-to-face MI and assessment feedback session. Adapted from CHOICES and BALANCE.	Informational video or informational brochure	AEP Risk[a] Drinks per drinking Day Contraception use, ineffective contraception rate	A decrease in AEP risk for intervention (44.9%) compared to controls (video = 63.8%, brochure = 54%) at 6 months. A decrease in ineffective contraception use for intervention (44.7%) compared to controls (video = 55.8%, brochure = 50.7%) at 6 months. Reductions in Drinks per drinking day with no significant difference between the intervention and control groups.

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Farrell-Carnahan et al., 2013 Transtheoretical Model	Low risk drinking: Drink less than 8 standard drinks in a week, drink less than 4 standard drinks at one go Effective contraception use at every sexual encounter	Model: Single session, dual-focused Intervention: EARLY Remote, a mailed package with personalised feedback followed by a 60-minute MI-based telephone call	None	AEP Risk[a] Drinks per Drinking Day, Contraception use, unreliable contraception use rate	Risky drinking decreased from 100% at baseline to 87.5% at 6 months ($p<0.01$). Drinks per Drinking Day decreased from 5.3 at baseline to 4.1 at 6 months The ineffective contraception use rate decreased from 100% at baseline to 75% at 6 months AEP risk decreased from 100% at baseline to 68.8% at 6 months ($p<0.01$).
Sobell et al., 2017 USA Transtheoretical model	Low risk drinking: Drink less than 8 standard drinks in a week, drink less than 5 standard drinks at one go Effective contraception use at every sexual intercourse	Model: Single-session dual-focused Intervention: Mail brochure adaptation of CHOICES in English and Spanish	Information-only brochures on FASD	AEP risk[a] Alcohol consumption Contraception use	Both intervention and control groups documented a decrease in AEP risk with no significant difference in risk reduction between groups. College students were significantly less likely than nonstudents to be at risk of an AEP at follow-up (OR = 2.1). Students' reduction in AEP risk was mediated mainly by effective contraception use at every sexual intercourse ($p = 0.040$).

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Project CHOICES Research Group, 2003 Transtheoretical model	Low risk drinking: Drink less than 8 standard drinks in a week, drink less than 5 standard drinks in a day. Effective contraception use at every sexual intercourse	Model: Multi-session dual-focused, face-to-face Intervention: CHOICES, 4 face-to-face MI sessions +1 contraceptive counselling session.	None	AEP risk[a] Alcohol use Contraceptive use	The percentage of women who were no longer at AEP risk at 6 months was 68.5%. 12.6% decreased risky alcohol consumption only 23.1% utilised effective contraception at every sexual intercourse to reduce the risk of pregnancy only 32.9% decreased both drinking and pregnancy risk
Floyd et al., 2007 Transtheoretical Model	Low risk drinking: Drink less than 8 standard drinks in a week, drink less than 5 standard drinks at one go Effective contraception use at every sexual intercourse	Model: Multi-session, dual-focused, face-to-face Intervention: CHOICES, 4 face-to-face MI sessions +1 contraceptive counselling session.	Information only	AEP Risk[a] Alcohol use Contraception use	Women in the intervention arm were more likely to reduce alcohol consumption to below risk levels (OR=1.5), use effective contraception (OR= 2.4) and be at reduced AEP risk (OR= 2.1) at the 9-month follow-up Significantly more women in the intervention group reduced their risk for an AEP, but many women in the control group also reduced their risk for an AEP

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Rendall-Mkosi et al., 2013 Adapted from CHOICES, which used the Transtheoretical model	Low risk drinking: Drink less than 8 standard drinks in a week, drink less than 5 standard drinks at one go Effective contraception use at every sexual intercourse	Model: Multi-session dual-focused, face-to-face Intervention: An adaptation of CHOICES with 5 MI face-to-face sessions with contraception content integrated instead of stand-alone.	A pamphlet with information on FASD prevention and a handbook on women's health	AEP Risk[a] Risky alcohol use Ineffective contraception use	A significantly greater reduction in the percentage of participants in the intervention group with ineffective contraception use (42.6%) than in the control group (25%); p=0.037 at 12 months follow-up. A significant difference in the decrease of the proportion of women at risk for an AEP in the intervention group (50.8%) compared to the control group (28.12%); p=0.009, OR=2.64 at 12 months follow-up. Both groups reduced risky drinking with no significant difference between groups.
Hutton et al., 2014 Transtheoretical model	Low risk drinking: Drink less than 8 standard drinks in a week, drink less than 4 standard drinks in one day Effective contraception use at every sexual intercourse	Model: Multi-session dual-focused, face-to-face Intervention: STD CHOICES; Modified CHOICES with varied session numbers from 1 to 5	None	AEP Risk[a] Alcohol use Contraception use	Baltimore: 83% decreased AEP risk, 18% decreased alcohol use only, 37% adopted effective contraception use only, 25% changed both behaviours at 6 months. Denver: 62% decreased AEP risk of which 19% decreased alcohol only, 19% adopted effective contraception use only, and 24% changed both behaviours at 6 months

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Hanson et al., 2017 Transtheoretical model	Low-risk drinking: Drink less than 8 standard drinks in a week, drink less than 4 standard drinks in a day Effective contraception use at every sexual intercourse	Model: Multi-session dual-focused, face-to-face Intervention: Oglala Sioux Tribe (OST) CHOICES. 1 site provided 4 MI sessions, and 2 sites provided 2 MI sessions.	None	AEP Risk[a] Alcohol consumption Contraception use Sexual abstinence	Significant decrease in proportion at risk for AEP from baseline (100%) to 6 months (a range of 18.1% to 66.3%) driven by effective contraception (61.5% at 6 months); 18.5 % of participants changed both contraception and alcohol use at 6 months; 20% of participants reduced alcohol consumption to below binge levels at 6 months; 23.9% were abstaining from sexual activity for pregnancy prevention at 6 months
Velasquez et al., 2017 Transtheoretical model	Low risk drinking: Drink less than 8 standard drinks in a week, drink less than 4 standard drinks in a day Effective contraception use at every sexual intercourse	Model: Multi-session dual-focused, face-to-face Intervention: CHOICES-PLUS: Two face-to-face 40-minute personalised MI sessions + contraceptive counselling	Referral to Community services and brief advice	Incidence Risk Ratios (IRR) of: AEP risk[a] Alcohol use Contraceptive use	A decrease in AEP risk[a] (IRR=0.620) in the intervention compared to the control group. A significant decrease in risk of alcohol use (IRR = 0.784) and ineffective contraception (IRR = 0.717) in the intervention compared to the control group.

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Parrish et al., 2019 Transtheoretical model	Low risk drinking: Drink less than 8 standard drinks in a week, drink less than 4 standard drinks in one day, Effective contraception use at every sexual encounter, and sexual abstinence	Model: Multi-session dual-focused, face-to-face Intervention: CHOICES TEEN, an adaptation of CHOICES and CHOICES Plus: Two motivational counselling sessions + 1 session focused on HIV risk reduction	None	AEP risk[a] Alcohol use Contraception use Sexual activity	19 participants (90%) were at reduced risk of AEP at 1 month, and 15 (71.4%) were at reduced risk at 3 months. Using an intent-to-treat analysis (treating the dropout as a failure), 86.4% were at reduced risk at 1 month, and 68.2% were at reduced risk at 3-months.
Isurina et al., 2021 Health Belief Model, Trans theoretical Model	Low risk drinking: Drink less than 7 drinks per week, less than 4 drinks on one occasion Effective contraception use at every sexual intercourse	Model: Multi-session dual-focused, face-to-face Intervention: Assessment, personalised feedback, and dual-focused brief intervention based on MI techniques	Informational brochure about the effects of alcohol on the foetus and FAS	AEP risk[a]	Significant decrease in AEP risk[a] in the intervention group (100% to 47.1%) compared to the control (100% to 62.1%) at 3 months, $p<0.05$, but this was difference was not sustained at 12 months (100% to 45.7% for the intervention group and 100% to 49.3% for the control group, $p>0.5$)

Citation, Underpinning theory	Target behaviours	Intervention Model and Intervention	Control	Alcohol & Contraception Outcomes	Key Findings
Okulicz-Kozaryn et al., 2023 Poland Adapted from CHOICES, which used the Transtheoretical model	Low risk drinking: Drinking consistent with an AUDIT C test score of less than 4 Effective contraception use at every sexual intercourse	Model: Multi-session dual-focused, face-to-face Intervention: FAR SEAS Pilot, CHOICES adaptation, with session number dependent on AEP risk. Low risk: 1 session; Moderate risk: 1-4 MI sessions; High risk: 4 or more MI sessions	None	Risky alcohol use Contraception use	Self-reported risky alcohol consumption dropped at 6 months follow-up $p<0.001$ (coefficient of variation =-81.25) Contraception use increased by 15% ($p<0.001$) Other analyses of outcomes done for both pregnant and non-pregnant women showed a decrease in psychosocial risk factors for AEP (tobacco use, domestic violence and current drug use)
Hanson et al., 2025 Transtheoretical model	Low-risk drinking: Less than 8 standard drinks in a week or 4 standard drinks in one day Effective contraception use at every sexual encounter	Model: Multi-session dual-focused, face-to-face Intervention: NATIVE CHOICES: 2 sessions + 1 optional contraception session.	Controls were placed on a waitlist and not offered any intervention until the end of the follow-up period.	AEP risk[a] Alcohol and contraceptive use	No significant difference in AEP risk[a] between intervention and control arm at 6 months follow-up (RR=0.94; 95% CI: 0.83–1.07). Subgroup analysis showed decreased AEP risk in intervention arm participants who completed the study in-person before the COVID-19 pandemic (RR = 0.79; 95% CI: 0.63–0.98) which was not observed during or after the pandemic (RR=1.06; 95% CI: 0.91‑1.24).

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Tenkku et al., 2011 Adapted from CHOICES, which used the Transtheoretical model	Low risk drinking: Drink less than 8 standard drinks in a week, drink less than 4 standard drinks at one go Contraception use at every sexual intercourse	Model: Multi-session dual-focused, remote/digital Intervention. Web-based self-administered intervention with 4 modules designed using personalised motivational messaging.	Mailed printed material with the same content	AEP risk[a] Alcohol consumption Contraception use	Intervention effectiveness did not differ with the mode of delivery An equal proportion of women in the web-based (23.1%) and the mail (22.0%) groups quit drinking at follow-up (OR = 1.06; 95% CI = 0.54, 2.10) Those in the web-based group (41.2%) were equally as likely to use effective contraception at follow-up compared with the mail-based group (50.8%; OR 0.68; 95% CI 0.38-1.19)
Wilton et al., 2013 Transtheoretical model	Low risk drinking: Drink less than 8 standard drinks in a week, drink less than 4 standard drinks at one go Contraception use at every sexual intercourse	Model: Multi-session dual-focused remote/digital Intervention: An adaption of Healthy Mom's and CHOICES: 2 MI and cognitive therapy-based sessions with content delivered via telephone	Same content delivered face-to-face	AEP risk[a] Alcohol consumption Contraception use	Significantly decreased risk of AEP (100% to 29%) and decreased alcohol use (100% to 84%) for both groups. Significantly decreased risk of pregnancy due to effective contraception (100 to 36%) for both groups. Telephone-based intervention was just as effective as face-to-face.

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Hanson et al., 2013 Transtheoretical Model	Low risk drinking: Drink less than 8 standard drinks in a week, drink less than 4 standard drinks at one go Contraception use at every sexual intercourse	Model: Multi-session dual-focused digital/remote Intervention: Phone-based-CHOICES, mailed material with personalised feedback +4 MI phone calls.	None	AEP risk[a] Alcohol consumption ("most drinks," average drinks, "average per week," consuming 3+ drinks on a single occasion over the previous 90 days) Effective contraception use (type of contraception used and how often in the previous 90 days)	AEP risk[a] decreased significantly (54%) between the baseline visit and all other visits ($p<.001$), but there were no differences between 3, 6, 9, and 12 months ($p <.531$). Significant decrease in alcohol use across all measures with each follow-up session. The proportion not using contraception decreased in the first 3 months (29 to 10%) but subsequently remained constant.
Ingersoll et al., 2018 Transtheoretical model	Low risk drinking: Drink less than 8 standard drinks in a week, drink less than 4 standard drinks at one go Contraception use at every sexual intercourse	Model: Multi-session dual-focused digital/remote Intervention: CARRII: 6 web-based interactive and tailored sessions adapted from CHOICES	Same content as CARRII but not personalised	AEP risk[a] Risky drinking Unprotected sexual intercourse	Significant decrease in AEP risk[b] in the intervention group from pretreatment (66.7%) to posttreatment (32.4%), which was sustained at 6-month follow-up (30.3%) ($p=0.005$); Significant reductions in rate of unprotected sex in the intervention group from baseline (88.9%) to posttreatment (70.6%) ($p<0.04$) which was sustained at 6-Months follow-up (51.5%) ($p = 0.001$) No significant changes in risky drinking in both arms at 6 months

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Kaufman et al., 2025 Transtheoretical model	Alcohol abstinence, Low risk drinking: Drink less than 8 standard drinks in a week, drink less than 4 standard drinks at one go Contraception use at every sexual encounter Sexual abstinence Consistent condom use	Model: Multi-session dual-focused digital/remote Intervention: NATIVE WYSE CHOICES, Mobile app-based MI sessions narrated by a character based on a social media influencer	Session topics focused on resume writing, financial literacy and budgeting, and professional development	Knowledge about AEP risk[a] Birth control effectiveness knowledge Sexual health practices self-efficacy AEP risk index Alcohol use Contraception use Consistent condom use Alcohol use with sexual activity	At 1-month follow-up, participants in the intervention group reported greater AEP knowledge, lower scores on an AEP risk index and lower likelihood of alcohol-involved sexual activity in the past month when compared to the control group. Regression analyses predicting scores on 1-month outcomes by study arm showed trending intervention effects on measures of AEP knowledge (p=0.06), use of alcohol with sexual activity (p = 0.10), and the AEP risk index (p = 0.12)

Footnote:

[a]AEP risk is an outcome describing the potential risk of alcohol consumption in pregnancy occurring from an overlap of a period of risk drinking and sexual activity without the use of an effective contraception method, as described in CHOICES (Floyd et al., 2007).

[b]Decrease in AEP risk refers to self-reported changes in either alcohol consumption and/or contraception use, which reduces the risk of overlap of a period of risky drinking and sexual activity without the use of an effective contraception method, as described in CHOICES (Floyd et al., 2007).

Articles are ordered by intervention model, beginning with alcohol-only educational, alcohol-only SBIs and then dual-focused. Within each model, articles are ordered from single-session to multi-session interventions. Multi-session dual-focused interventions are further ordered from face-to-face to digital/remote.