



# Prenatal Alcohol Screening During Pregnancy by Midwives and Nurses

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**Background:** Alcohol use during pregnancy can have a variety of harmful consequences on the fetus. Lifelong effects include growth restriction, characteristic facial anomalies, and neurobehavioral dysfunction. This range of effects is known as fetal alcohol spectrum disorders (FASD). There is no amount, pattern, or timing of alcohol use during pregnancy proven safe for a developing embryo or fetus. Therefore, it is important to screen patients for alcohol use, inform them about alcohol's potential effects during pregnancy, encourage abstinence, and refer for intervention if necessary. However, how and how often nurses and midwives inquire about alcohol drinking during pregnancy or use recommended screening tools and barriers they perceive to alcohol screening has not been well established.

**Methods:** This survey was sent to about 6,000 American midwives, nurse practitioners, and nurses who provide prenatal care about their knowledge of the effects of prenatal alcohol exposure, the prevalence of alcohol use during pregnancy, and practices for screening patients' alcohol use. Participants were recruited by e-mail from the entire membership roster of the American College of Nurse-Midwives.

**Results:** There were 578 valid surveys returned (about 9.6%). Analyses showed that 37.7% of the respondents believe drinking alcohol is safe during at least one trimester of pregnancy. Only 35.2% of respondents reported screening to assess patient alcohol use. Only 23.3% reported using a specific screening tool, and few of those were validated screens recommended for use in pregnant women. Respondents who believe alcohol is safe at some point in pregnancy were significantly less likely to screen their patients.

**Conclusions:** Respondents who reported that pregnancy alcohol use is unsafe felt more prepared to educate and intervene with patients regarding alcohol use during pregnancy and FASD than respondents who reported drinking in pregnancy was safe. Perceived alcohol safety and perceived barriers to screening appeared to influence screening practices. Improving prenatal care provider knowledge about the effects of prenatal alcohol exposure and the availability of valid alcohol screening tools will improve detection of drinking during pregnancy, provide more opportunities for meaningful intervention, and ultimately reduce the incidence of FASD.

**Key Words:** Fetal Alcohol Spectrum Disorders, Fetal Alcohol Syndrome, Alcohol Consumption, Prenatal (Antenatal) Care, Midwifery, Nurse Practitioners, Maternal Alcohol Consumption.

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**D**ESPITE DECADES OF research demonstrating the risk that drinking alcohol during pregnancy poses to the developing embryo or fetus, approximately 10% of pregnant women admit to alcohol consumption during the past month, and about 50% admit to drinking at some point during their first trimester, often prior to being aware that they were pregnant (CDC, 2015; Khalil and O'Brien, 2010; SAMHSA, 2014). Alcohol use during pregnancy can have a variety of harmful consequences to the fetus including growth restriction, characteristic craniofacial dysmorphism, and a wide range of lifelong cognitive and neurobehavioral deficits (e.g., Glass et al., 2014; Panczakiewicz et al., 2016; Warren et al., 2011). The full range of physical, physiological, and behavioral effects, which can be devastating for individuals and families (Cannon et al., 2012; Floyd et al., 2006, 2009; Paley et al., 2006), is known as fetal alcohol spectrum disorders (FASD), the most severe of which is diagnosed as fetal alcohol syndrome (FAS; Hoyme et al., 2016).

Popova and colleagues (2017a, 2017b) estimated that on average about 1.5 of every 1,000 people worldwide will have

FAS. In the United States, the prevalence of FAS has exceeded that of other birth defects such as anencephaly, spina bifida, and trisomy 21 (Down syndrome; Parker et al., 2010). Using case ascertainment methods, May and colleagues (2018) estimated that the prevalence of the full-range FASD ranges from 31.1 to 98.5 per 1,000 children in the United States. These and similar earlier estimates from other countries (May et al., 2011, 2013; Roozen et al., 2016) helped inspire a *Vital Signs* alert<sup>1</sup> from the Centers for Disease Control and Prevention in early 2016 (Green et al., 2016).

The lifetime additional costs of recognized FASD due to health care, educational accommodation, lost productivity, and judicial/corrections involvement, per individual and for societies, are difficult to estimate but are considerable, ranging from hundreds of millions to billions US\$ (Popova et al., 2011; Stade et al., 2009). According to one estimate, more than \$4 billion is spent annually on FASD, and beyond the healthcare and judicial expenditures, there are also significant emotional, personal, familial, and wider social costs (Stade et al., 2006, 2007). Given these high costs, the need to invest in effective prevention efforts, including enhanced screening of alcohol drinking during pregnancy, is clear (Smith et al., 2014).

Screening for alcohol use during pregnancy by primary care providers, including nurse-midwives, is a necessary first step in the primary prevention of FAS and other FASDs (Floyd et al., 2010; Tzilos et al., 2011). Although screening for in-pregnancy drug and alcohol use integrated into regular practice is promoted as a clinical imperative for midwives, research suggests that midwives do not screen consistently for alcohol use and are hesitant to follow up with women who report drinking missing opportunities to educate and refer patients for follow-up and referral (Goodman and Wolff, 2013). Payne and colleagues (2014) found that although most Australian midwives (93.2%) reported asking their patients about alcohol use, less than half used a recommended screening tool and 70.4% reported they did not intervene when appropriate. Importantly, almost all midwives in that study recognized the need for ongoing professional development in the prevalence of in-pregnancy alcohol use and FASD (92.9%), and in using alcohol screening tools (93.5%; Payne et al., 2014).

There have been few studies of what providers know about the effects of prenatal alcohol. Watkins and colleagues (2015) surveyed midwives in Western Australia about assessing alcohol use during pregnancy, including positive and negative consequences of asking and their capacity to assess drinking (Watkins et al., 2015). They reported that midwives were most positive about their capacity to ask and the effectiveness of asking, and least positive about patients' knowledge about the effects of alcohol use and their own comfort in asking. Watkins and colleagues (2015) did not assess screening practices, but a prerequisite for screening is an

awareness of the potentially damaging effects of alcohol during pregnancy (Floyd et al., 2009; Goodman and Wolff, 2013) and belief that screening is effective and acceptable to patients. Yet providers often reported feeling unprepared to educate their pregnant patients about the risks of prenatal alcohol because they themselves do not fully understand the effects.

We studied American midwives because most prior studies were done in Australia or England. It is important to study midwives because their clinical practice is focused exclusively on pregnant women in contrast to OB/GYNs and other general primary care settings. A study of American OB/GYN physicians had been done (Anderson et al., 2010), and in part, we expanded upon that study by basing our survey on the survey used for that study. Prior studies show that all prenatal care providers, including obstetricians and nurse-midwives, report inconsistent or incomplete knowledge about the effects of alcohol on the fetus (Anderson et al., 2010; Herzig et al., 2006; Jones et al., 2011; Payne et al., 2014) and may believe that small, occasional amounts of alcohol use during pregnancy are not harmful, a belief they often convey to their patients (Anderson et al., 2010; Herzig et al., 2006; van der Wulp et al., 2013). An "off-the-record" report of 30 midwives showed that some believed that abstinence should not be recommended or was futile, and some indicated the need to inform women of the "safe" level of pregnancy alcohol use (RCM Midwives, 2006). Holmqvist and Nilsson (2010) reported that while 93.7% of 971 midwives in Sweden reported they possessed good-to-excellent knowledge about the risks of drinking in pregnancy, almost 40% reported only fair-to-poor knowledge about how to detect risk drinking.

The perceived barriers to antenatal alcohol screening most commonly reported by primary care providers include a lack of understanding about the consequences of alcohol exposure on the fetus and insufficient knowledge about how to screen effectively during pregnancy (Aalto et al., 2001; Anderson et al., 2010; van der Wulp et al., 2013). Some providers report feeling uncomfortable discussing alcohol use with their patients because the topic seems too personal, or the providers think they may come across to their patients as judgmental (Jones et al., 2011; Seib et al., 2012; Wallman et al., 2011). However, surveys of pregnant women have not revealed discomfort on their part at being asked about their alcohol use (Jones et al., 2011; Seib et al., 2012; Smith et al., 2014).

The purpose of the current study was to describe, in a national sample of professional American midwives and nurse-midwives, their self-reported knowledge of the prevalence, levels and risks of drinking alcohol during pregnancy, attitudes toward drinking during pregnancy, knowledge of the prevalence and characteristics of FASD, awareness of and current practice in using standardized clinical screening tools during pregnancy, perceived barriers to in-pregnancy alcohol screening and intervention, and the relationships among midwives' knowledge in these areas and their clinical practice.

<sup>1</sup><https://www.cdc.gov/vitalsigns/pdf/2016-02-vitalsigns.pdf>.

## MATERIALS AND METHODS

### *Sample*

A heterogeneous sample of certified nurse-midwives (CNMs), certified professional midwives (CPMs), certified midwives (CMs), women's health nurse practitioners (WHNPs), and nurses (RNs) who provide prenatal care in the United States were invited to participate. Participants were recruited via the American College of Nurse-Midwives (ACNM) national membership roster. At the time of the survey, ACNM reported a membership of about 6,000 members.

### *Procedure*

The University of Massachusetts Institutional Review Board and ACNM gave prior approval for this study. Participant consent was granted by completing the survey. Participants were recruited initially via e-mail sent to multiple community midwifery groups (e.g., *Squat Birth Journal* and *Midwifery Today*). After 1 month of recruitment, survey response was low ( $N = 26$ ) and approval was received from ACNM to recruit via member listserv. An e-mail was sent from the ACNM office to the full ACNM membership e-mail list. The e-mail contained a link to the online survey. The survey asked several detailed questions regarding FASD knowledge and prenatal alcohol use screening practices. No incentive was provided for completing the survey. No identifying data were collected. This study was funded by the UMass College of Nursing.

### *Measures*

A survey of knowledge about FASD and alcohol screening practices used previously with obstetricians by Anderson and colleagues (2010) was adapted for use with nurses and midwives. The questionnaire asked respondents to rate the safety of drinking alcohol during pregnancy by trimester, the levels and patterns of drinking they considered to be safe or not, knowledge about FASD and its prevalence in the general population as well as locally and in different Social Economic Status (SES) groups or in different cultures and ethnic groups, their alcohol screening practices (including screening tool type), a ranking of perceived barriers to screening, and ratings of how prepared the nurse-midwife felt they were to screen, educate, intervene, and utilize resources for patient referral.

### *Data Analysis*

Since the purpose of this study was to describe midwife practice, knowledge, and beliefs, most analyses presented are descriptive. The data set was described by calculating means and variances (SDs) and/or percentages for responses to each demographic and professional characteristic question and each survey item. These descriptive

statistics were calculated for the sample as a whole and broken down by various subgroups (e.g., certification type, years in practice) and/or by response categories to certain items. For example, item responses were categorized by levels of knowledge and/or by perceived barriers to screening (e.g., Table 6).

When comparing mean differences between groups, independent-groups *t*-tests were performed for dichotomous groups, while ANOVA was used if there were more than 2 levels in the predictor variable. To compare proportional differences in unrelated groups, a chi-square analysis was performed. When comparing proportional differences in related groups, the sign test for related groups was employed. Level of statistical significance was set at  $\alpha \leq 0.05$ . Analyses were performed using SPSS V.23.

## RESULTS

### *Sample*

From the potential pool of an estimated 6,000 registered members (ACNM report at the time of the survey), 581 (~9.6%) responded within 6 weeks of posting the survey (October/November, 2014). Among the 581 respondents, 3 indicated that they had never provided prenatal care and were removed from further analyses, leaving a final sample of 578 respondents. The majority reported that their primary place of employment was a hospital/clinic or group practice (70.3%). Although a few indicated primary employment as "student," they were retained in the analysis because they indicated they provided prenatal care. Providers affiliated with a university or medical school had significantly more years of practice than those at a community-based health center ( $p = 0.021$ ) or hospital/clinic ( $p = 0.026$ ). See Table 1 for demographic and professional characteristics.

Although it is not possible to directly compare demographic characteristics between the respondents who participated in the survey and members of ACNM who did not, we compared study sample characteristics to the ACNM Core Data Survey,<sup>2</sup> ACNM (2010) which collects demographic and employment characteristics of the ACNM membership annually. We examined the most recent Core Data available on the ACNM website. Other than age, our sample characteristics are comparable to the ACNM Core Data ( $N = 1,998$ ): Most were female (98.7%), White (91.9%), and certified nurse-midwives (93.2%). Respondents in our sample were younger than the overall median age in the ACNM Core Data (53 years) but similar to Sipe and colleagues (2009) who, using ACNM Core Data, reported a median age of 48 years for certified nurse-midwives. In our sample of

<sup>2</sup><http://www.midwife.org/Core-Data-Survey>; downloaded on January 30, 2019.

**Table 1.** Sample Characteristics ( $N = 578$ )

Characteristics	% or mean (SD)
Race (% White)	94.8
Ethnicity (% not Hispanic)	97.6
Gender (% female)	99.3
Age (range 20 to 77 years)	46.2 (12.5)
Degree/certification (%) <sup>a</sup>	
Certified nurse-midwife	92.9
Certified professional midwife	2.1
Certified midwife	0.7
Nurse practitioner	13.3
Registered nurse	17.6
Years in practice	
Total years	15.5 (11.2) <sup>b</sup>
Percent practicing $\geq 10$ years (%)	63.2
Employment site type (%) <sup>c</sup>	
Hospital or clinic	41.6
Group practice	28.7
Solo/2-person practice	9.8
Community-based health center	8.5
Medical school/affiliated university	6.4
Free-standing birthing center	2.6
Student	2.3

<sup>a</sup>Adds up to  $>100\%$  because some respondents reported multiple degrees/certifications.

<sup>b</sup>Mean values reported for valid  $N = 566$ .

<sup>c</sup>Percentage of respondents working at each type of practice site (Valid  $N = 574$ ).

mostly certified nurse-midwives, the median respondent was 46 years old.

### Knowledge and Attitudes

Respondents rated their views of the safe alcohol use during pregnancy on a 6-point Likert scale (1 = Strongly Agree “safe” to 6 = Strongly Disagree “not safe”). Mean safety rating was 4.9 (SD = 1.4), indicating most participants thought alcohol was not safe during pregnancy. Respondents were also asked if alcohol use was safe (“yes/no”) for each trimester of pregnancy and ever in pregnancy. There were 9 providers who said “no,” that alcohol was not safe at any point in pregnancy, but who also thought alcohol was safe in at least 1 trimester. These “no” responses were recoded as “yes.” Based on the overall “yes/no” question, 37.7% considered alcohol is safe to drink in pregnancy. Among 215 respondents who considered alcohol safe at some time during pregnancy, the vast majority considered the third trimester as safe, about half considered the second trimester safe, and relatively few identified the first trimester as safe (Table 2). Also, 70 respondents considered drinking alcohol safe in 2 trimesters and 36 more considered alcohol safe in all 3 trimesters. Overall, 49.3% (of these 215 respondents) considered drinking safe in at least 2 trimesters (see Table 3).

In addition to an overall safe/not safe assessment, respondents were asked the total number of drinks per week and per drinking occasion they considered safe during pregnancy. The number of drinks considered safe *per week* ranged from 0 to 14 (modal number of drinks was 0; modal % = 56.1); 1

**Table 2.** Perceived Safety of Alcohol Consumption

Trimester	$N$	Percent reporting “Safe to Use”	
		% of whole sample <sup>a</sup> ( $N = 571$ )	% among those reporting “Safe” use at some time ( $N = 215$ )
Any	215	37.7	100.0
1st	40	7.0	18.6
2nd	114	20.0	53.0
3rd	203	35.6	94.4
More than 1	70	12.3	32.6
All	36	6.3	16.7

<sup>a</sup>Seven respondents did not answer this question.

**Table 3.** Perceived “Number of Drinks That are OK” in Pregnancy (% of Sample)

Number of drinks	Per week		Per drinking occasion	
	Entire sample <sup>a</sup>	“Safe” in at least 1 trimester of pregnancy <sup>b</sup>	Entire sample <sup>c</sup>	“Safe” in at least 1 trimester of pregnancy <sup>d</sup>
0	56.1	14.2	53.7	11.7
1	21.0	34.0	43.6	83.6
2	13.6	29.7	2.4	4.2
3 or 4	5.7	13.2	0.2	0.0
5 or more	2.6	9.0	0.2	0.5

<sup>a</sup> $N = 572$ .

<sup>b</sup> $N = 212$ .

<sup>c</sup> $N = 574$ .

<sup>d</sup> $N = 214$ .

provider reported 14 drinks per week safe. The majority considered zero drinks *per occasion* acceptable during pregnancy (53.7%); 43.6% reported 1 drink per occasion was acceptable. Among those who considered alcohol safe in at least 1 trimester of pregnancy, the modal number of “acceptable” drinks was 1 (34.0%); 29.7% reported 2 drinks were safe, and 11.8% reported 3 drinks. The majority of this subgroup (83.6%) considered it acceptable to have only 1 drink per occasion. Only one respondent considered binge drinking (i.e.,  $\geq 4$  drinks per occasion for women) safe in pregnancy (see Table 3).

There was a significant relationship between respondent age and safe drinking ratings during pregnancy ( $t = 4.85$ ,  $p < 0.001$ ). Respondents who considered alcohol use as safe in at least 1 trimester (mean age = 42.9 years, SD = 12.7) were 5.1 years younger (95% CI = 3.0 to 7.2) than those who considered pregnancy alcohol unsafe (48.0 years, SD = 11.9). Of course, since respondent age and years of experience providing prenatal care were highly correlated ( $r = 0.83$ ,  $p < 0.001$ ), it is not possible to assess these constructs independently. Since there was very high homogeneity in respondent gender, race, and ethnicity, most being non-Hispanic White females, the influences of these factors on perceptions of alcohol safety were not examined.

*Knowledge of FASD Prevalence*

Only 21.2% of the sample correctly identified (within orders of magnitude) the then-accepted U.S. prevalence rates for FASD as about 1 in 100 births (May et al., 2009; O'Connor and Whaley, 2007); 77.9% thought prevalence rates in their communities were lower (1 in 1,000 or less), while only 0.9% reported higher prevalence rates (1 in 10). The difference within their own community and own practice was statistically significant (sign test for related populations:  $Z = -2.03, p = 0.042$ , and  $Z = -3.24, p = 0.001$ , respectively; see Table 4).

We evaluated views of FASD prevalence rates in their own communities and patient populations relative to their knowledge of national FASD prevalence rates. Responses were grouped by prevalence report accuracy (“higher” or >1/100; “accurate” = 1/100; and “lower” or < 1/100). Among the subset (21.1%) who accurately identified the national prevalence rate of 1%, 35.8% thought the FASD rate in their community was lower and 43.0% thought the rate in their patient population was lower. Over half of the respondents correctly reported that FASD rates are different across SES groups (58.6%), and 71.8% correctly indicated that FASD rates also differ across cultural and ethnic groups. The survey did not ask about racial group differences, and it is not known if respondents considered culture or ethnicity to include race.

Three additional FASD knowledge questions were asked: (i) “The effects of alcohol on development are clear”: 40.5% correctly identified as “true”; (ii) “Fetal alcohol exposure is a risk factor for brain damage”: 84.5% correctly identified as “true”; and (iii) “Alcohol withdrawal is the worst outcome of pregnancy alcohol use”: 92.9% correctly identified as “false.” Correct answers were totaled across 6 questions asking about knowledge of FASD yielding a possible range of 0 to 6. The mean “total knowledge score” was 3.7 (SD = 1.1, min = 0, max = 6); 40.2% of the respondents scored <4; only 3.3% accurately answered all questions.

**Table 4.** Comparisons of Perceived FASD Prevalence Rates

	National prevalence			Z (sign test)
	Higher N = 5	Accurate N = 120	Lower N = 445	
<b>Community prevalence</b>				
Higher (N = 12)	0.7%	1.1%	0.4%	-2.03, p = 0.42
Accurate (N = 90)	0.2%	12.5%	3.2%	
Lower (N = 468)	0.0%	7.5%	74.6%	
<b>Practice prevalence</b>				
	Higher N = 5	Accurate N = 121	Lower N = 447	
Higher (N = 11)	0.3%	1.0%	0.5%	-3.24, p = 0.001
Accurate (N = 81)	0.3%	11.0%	2.8%	
Lower (N = 481)	0.2%	9.1%	74.7%	

*Screening Practices*

Less than one-quarter (22.6%) reported that their practice had a specific alcohol screening tool in use. Respondents rated on a 4-point scale (1 = all the time to 4 = none of the time) how frequently they used a screening tool. They were also asked (“yes” or “no”) if they used these screening tools: AUDIT, AUDIT-C, CAGE, MAST, NET, 4Ps or 5Ps, T-ACE, and TWEAK. A provider using any of these screens was categorized as positive for screening tool use. Although an “other” category was an option, no alcohol screening tool other than those listed was reported.

In rating screening frequency, only 11.6% screened all of the time, 8.6% screened most of the time, and 15.1% screened some of the time. Thus, only 35.2% of respondents screened at least some of the time. Only 28.2% reported a specific screening tool, and among those, 80.0% reported using the CAGE. The second most common screen was the ACOG-recommended T-ACE (12.3%). The AUDIT or AUDIT-C, recommended by SAMHSA, was used by 6.7%, and 10.4% used another specified tool (MAST, NET, 4Ps, 5Ps, TWEAK). Some respondents indicated they did screen (N = 55; 9.6%), but did not specify a tool.

*Interventions*

Although 80.6% of the respondents reported recommending abstinence to women who report drinking alcohol during pregnancy, only 25.3% reported advising reducing drinking. Thus, facing a woman who admits drinking alcohol while pregnant, only half (56%) advise abstinence during pregnancy and 11.9% advise neither reducing nor abstaining from drinking.

*Evaluation of Screening Practice by Perceived “Alcohol Safety” and Knowledge*

Analyses examining the relationship between perceived safety of pregnancy alcohol use and screening practices were performed using both screening rate variables. For the variable based on *screening frequency*, providers who screened at least some of the time were coded as “screeners” and compared to “non-screeners.” The second variable was constructed from “yes/no” screen questions for each specific screening tool. Similarly, 2 assessments of perceptions of the *safety of drinking* while pregnant were used. For the first, respondents who agreed (“Strongly Agree,” “Agree,” or “Somewhat Agree”) drinking was safe were coded as the “Safe” group, and those who disagreed (“Strongly Disagree,” “Disagree,” or “Somewhat Disagree”) were coded as “Not Safe.” The second “safety” variable was based on the single question “In your opinion, is it safe for pregnant women to consume alcohol?” Respondents who said alcohol use was safe in any trimester were coded as “Safe,” and those who reported alcohol as not safe in any trimester were coded “Not Safe.”

Analyses of reported screening practice, broken down by the providers' ratings of drinking safety (Table 5), were significantly different for both safety variables. Among all analyses, respondents who reported they screen for alcohol use in pregnancy ("Screeners") were significantly more likely to view drinking alcohol in pregnancy as "unsafe." This relationship was significant for all analyses except when screening was based on specific screening tools and safety was based on the single "yes/no" question.

#### FASD Knowledge by Safety and Screening Practice

To examine the relationship between FASD knowledge and Safety and Screening Practice, a 4-group "safe-by-screen" variable was constructed using the dichotomous "safe in any trimester" question and the "screening frequency tool" question. The "yes/no" assessment of any screening tool was not used in this analysis because not all possible screening tools were among the responses. Thus, the dichotomous "Non-Screener/Screeners" variable was used to construct the safe-by-screen variable. In this variable, respondents were categorized into 4 groups based upon their combined alcohol safety rating ("SAFE" or "NOT SAFE") and use of an alcohol screen ("SCREENS" or "DOESN'T SCREEN"): (i) SAFE/DOESN'T SCREEN,  $N = 149$ ; (ii) SAFE/SCREENS,  $N = 64$ ; (iii) NOT SAFE/DOESN'T SCREEN,  $N = 217$ ; and (iv) NOT SAFE/SCREENS,  $N = 136$ . Analyses compared the 4 groups' average knowledge scores. Results identified a significant overall difference in knowledge score by safe-by-screen group ( $F = 4.47$ ,  $p = 0.004$ ). Regardless of screening, *post hoc* analyses found that respondents who perceived alcohol use as "safe" (i.e., the SAFE/DOESN'T SCREEN group,  $M = 3.5$ ,  $SD = 1.1$ , and the SAFE/SCREENS group,  $M = 3.5$ ,  $SD = 1.1$ ) had significantly lower total knowledge scores than both groups of respondents who perceived drinking as "not safe" (i.e., NOT SAFE/DOESN'T SCREEN,  $M = 3.8$ ,  $SD = 1.1$ , and SAFE/SCREENS,  $M = 3.9$ ,  $SD = 1.1$ ;  $p = 0.025$  and  $p = 0.002$ , respectively). These results support our hypothesis that providers who know more about the risks of alcohol use

during pregnancy and about FASD view alcohol as less safe for use in pregnancy. However, increased knowledge is not related to increased rates of screening practice.

#### Perceived Barriers to Screening

Nine potential barriers to screening for alcohol use during pregnancy were ranked by the respondents (Table 6). The higher the rank (i.e., lower number), the more influential or important was the perceived barrier. The barriers perceived having the most impact were patient denial/treatment resistant and time limitations. Significant differences among the safe-by-screen groups were found for the following top-ranked (ranked first or second highest) barriers: patient denial/sensitivity, patient sensitivity, lack of training, and no available tool. Patient denial was more often viewed as one of the top 2 barriers among those who consider alcohol unsafe than providers who reported alcohol use safe in at least 1 trimester. In contrast, patient sensitivity was more often listed among the top 2 barriers for providers who consider alcohol use safe compared to those who view alcohol unsafe. Providers who do not screen listed patient sensitivity and lack of an available tool as one of the top 2 barriers more frequently than providers who do screen.

#### Preparedness to Screen

Similar to the analyses above, the drinking "safe-by-screening" groups—(i) SAFE/DOESN'T SCREEN, (ii) SAFE/SCREENS, (iii) NOT SAFE/DOESN'T SCREEN, and (iv) NOT SAFE/SCREENS—were also compared across the 4 questions asking how prepared respondents felt they were to (i) screen women for risky/problem drinking, (ii) educate women regarding the effects of prenatal alcohol exposure, (iii) conduct a brief intervention, and (iv) utilize resources if necessary. All 4 questions were rated on a 5-point scale (1 = "Not prepared at all" to 5 = "Very well prepared"). Analysis found significant differences among the safety-by-screening groups for all 4 "preparedness" questions (Screen:  $F = 10.0$ ,  $p < 0.001$ ; Educate:  $F = 8.1$ ,  $p < 0.001$ ; Intervene:  $F = 11.6$ ,  $p < 0.001$ ; Refer:  $F = 6.5$ ,  $p < 0.001$ ). *Post hoc* analyses identified that the group that felt best prepared also considered pregnancy alcohol use as unsafe and screened. Providers who screened, but considered alcohol use during pregnancy as safe, felt more prepared to screen, intervene, and refer than those who did not screen. Providers who believed pregnancy alcohol use was safe and still screened felt less prepared to educate patients than those who did not screen but considered alcohol use as unsafe (see Fig. 1).

## DISCUSSION

The present results demonstrate that in this sample of American nurse-midwives, 37.7% of the respondents believe

**Table 5.** Screening Practice by Views of Alcohol Safety in Pregnancy

	By screening frequency rating			By "yes/no" use of screening tools		
	Non-Screeners	Screeners	$\chi^2$	Non-Screeners	Screeners	$\chi^2$
<b>By safety rating</b>						
Safe	11.5%	3.7%	5.2 <sup>b</sup>	59.1%	3.0%	4.1 <sup>b</sup>
Unsafe	53.3%	31.5% <sup>a</sup>		12.3%	25.6% <sup>a</sup>	
<b>By "yes/no" trimester safety</b>						
Safe	26.3%	11.3%	4.2 <sup>b</sup>	28.2%	9.5%	1.8
Unsafe	38.3%	24.0% <sup>a</sup>		43.4%	18.9%	

<sup>a</sup>Among Screeners, the percent rating drinking "Unsafe" in pregnancy was significantly greater than those rating it "Safe."

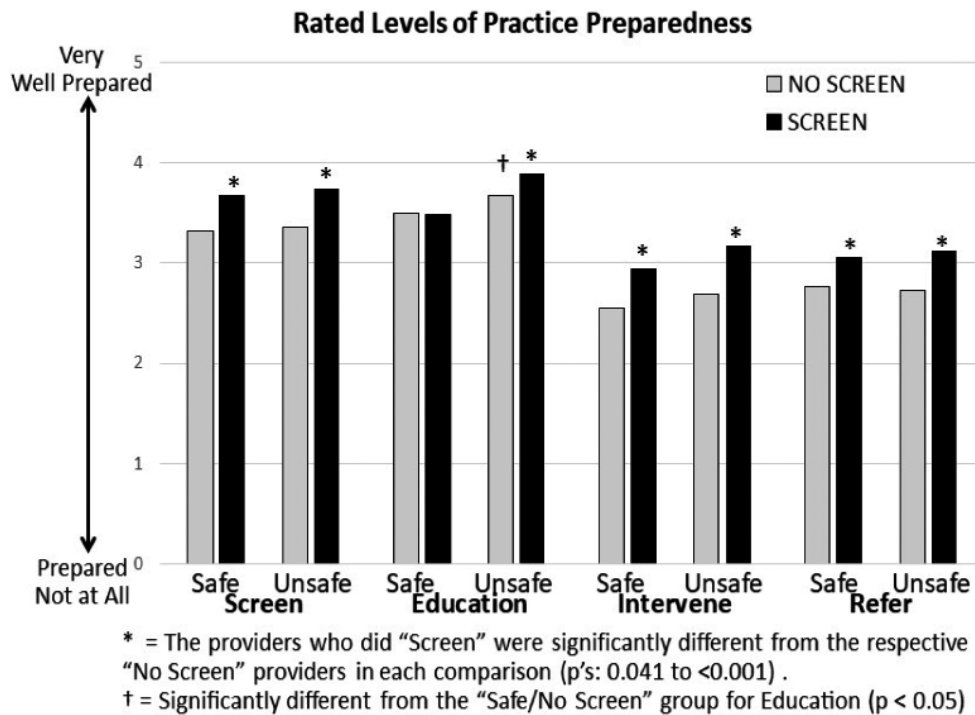
<sup>b</sup> $p < 0.05$ .

**Table 6.** Barriers: 1st or 2nd Ranked by Screening Practice and Perceived Safety

		SAFE		UNSAFE		$\chi^2$
		DOESN'T SCREEN N = 145	SCREENS N = 61	DOESN'T SCREEN N = 210	SCREENS N = 128	
		% reporting each barrier in one of the top 2 ranks				
Rank-ordered barriers <sup>a</sup>						
1	Patient denial/resistance	37.5	36.1	45.7	54.3	9.7 <sup>b</sup>
2	Time limitations	41.7	57.4	48.6	42.2	5.6
3	Patient sensitivity	30.3	36.1	20.5	33.3	10.1 <sup>b</sup>
4	Lack of training	26.9	14.8	21.4	14.0	8.4 <sup>b</sup>
5	Poor resources	20.7	19.7	20.5	28.1	3.4
6	Confidentiality	11.0	18.0	11.0	15.6	3.4
7	No available tool	25.5	8.2	24.3	4.7	30.2 <sup>b</sup>
8	Patient unable to pay	4.1	3.3	6.2	5.5	1.2
9	Lack of reimbursement	2.8	6.6	1.9	3.1	3.6

<sup>a</sup>Rank order of most commonly perceived barriers, based on total N = 544.

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001.



**Fig. 1.** Preparedness levels by Screen/Safe group.

that it is safe to drink alcohol during at least 1 trimester of pregnancy. This belief among providers can have important implications for pregnancy and child outcome. Only 35.2% of the respondents reported screening pregnant women for alcohol use by any means, and only 23.3% used a specific screening tool. Also, only half (56%) reported that they recommend abstinence to pregnant patients who admit to drinking alcohol, less than the 78% of American obstetricians who reported advising abstinence using a similar survey (Anderson et al., 2010). However, the midwives and nurses

in this sample used specific screening tools more frequently (23.3%) than the obstetricians (10%; Anderson et al., 2010). The respondents tended to underestimate the prevalence of FASD in the general population and more so in their own communities and patients. The respondents' level of knowledge about FASD was related to both their perceptions about the safety of drinking during pregnancy and their alcohol screening practices. That is, the less they reported they know about the risks of alcohol, the less likely they were to screen, refer, and intervene.

## Knowledge

Relatively few respondents in the current research (21.2%) knew the generally accepted prevalence of FASD in the United States at the time of the survey—approximately 1% of live births. Over 3-quarters of the sample thought FASD rates were lower nationally and within both their community and practice. Even among respondents who accurately identified the national prevalence rate, large proportions underestimated the FASD rate in both their community and their own patient population. Assessment of the accuracy of the nurse-midwives' perceptions about the prevalence of FASD is limited by how certain those estimates are and how well that information is communicated to and learned by providers. At the time this survey was conducted, we found no information about FASD in the professional resource library on the ACNM website although a position statement on *Screening and Brief Intervention to Prevent Alcohol-Exposed Pregnancy* was posted in May 2017<sup>3</sup>. American College of Nurse-Midwives after the CDC *Vital Signs Alert* was promulgated (Green et al., 2016). There had been a link to information about a collaborative FASD preventative project with a community-based organization, The Arc, but the link to this site was no longer active as of this writing. The generally accepted prevalence rate of about 1% was promulgated by health agencies such as the Substance Abuse and Mental Health Services Administration (SAMHSA, 2006) and the CDC at the time of the survey (e.g., May et al., 2009, 2011; Sampson et al., 1997). More recent estimates of rates of FASD up to 5% in the general population, as cited above in the Introduction section (cf. May et al., 2013, 2014, 2018; Popova et al., 2017a,b, 2018; Roozen et al., 2016), may influence the perceptions of midwives about both national and local prevalence of FASD depending upon how aware nurse-midwives are of those reports.

Greater knowledge about FASD and the risks of prenatal alcohol exposure was related to nurse/midwives viewing drinking alcohol in pregnancy as less safe. Knowledge of FASD and risk of alcohol use in pregnant women did not influence screening practice. Although not examined in this study, it would be interesting to evaluate which providers had received specific education about FASD during either their undergraduate or graduate training. Since there is no significant relationship in this sample between knowledge of FASD and provider age, years in practice, or provider practice site (including student group), and since younger midwives were more likely to view alcohol use during pregnancy as safe, we cannot assume that the content of current standard nursing curricula includes information about prenatal

drinking and FASD. Given that increased knowledge is related to viewing alcohol use as less safe during pregnancy, it is important that specific training about pregnancy alcohol use, including screening tools and the effects of alcohol use on the fetus, is included in all nursing curricula.

## Screening for Prenatal Alcohol Use

Screening practices vary across specialty, with the highest rates found among midwives and the lowest among obstetricians. This may be due in part to how responsibilities are organized in various practice settings (Jones et al., 2011; Mehta et al., 2009). Consistent with reports in other countries and professions (e.g., Anderson et al., 2010; Goodman and Wolff, 2013; Holmqvist and Nilsen, 2010), relatively few American midwives in the present study use a standardized, validated screening tool although they may ask a simple "yes/no" question. Among respondents who do use a standardized tool, the most commonly used was the CAGE. American obstetricians were more likely to use either the T-ACE or CAGE screens (Anderson et al., 2010), whereas Swedish midwives more frequently use the AUDIT (Holmqvist and Nilsen, 2010).

Current alcohol screening tools tend to focus on various personal or social problems associated with risk drinking, and each has strengths and weaknesses (Chang, 2001; Goodman and Wolff, 2013; Mengel et al., 2006). Some add questions about frequency or amount of drinking (Chiodo et al., 2014; Smith et al., 2014). Asking indirectly about drinking behavior or its consequences can improve candor (e.g., Ondersma et al., 2012). For example, the CAGE focuses on self-perceptions about the personal impact of drinking or feeling annoyed when others criticize their drinking, but the CAGE has limited sensitivity and specificity (Chang et al., 2010; Floyd et al., 2010; Volk et al., 1997). The CAGE and the AUDIT were designed for a general population. Neither is validated for use in pregnant women. The ACOG-endorsed, highly sensitive T-ACE and the TWEAK, both adapted from the CAGE, were validated for pregnant women (Russell, 1994; Russell et al., 1994; Sokol et al., 1989) but are used, respectively, by only 12.3% and 2.5% of the midwives/nurses in the current study.

The T-ACE screen is endorsed by ACOG (2006) because its high sensitivity helps meet a goal of (theoretically) identifying every woman who may be drinking at fetal-risk levels. However, the trade-off of high sensitivity with relatively poorer specificity can result in a high false-positive rate which jeopardizes appropriate allocation of scarce resources in practice and effectively limit opportunities to intervene with the women most in need. We have established a more specific, clinically effective brief screening tool with a revised version of the T-ACE, the TACER-3. The TACER-3, using an increased total score cut-point, reduced false positives while maintaining high sensitivity in predicting both maternal risk drinking and alcohol-related child neurobehavioral outcomes (Chiodo et al., 2010, 2014).

<sup>3</sup>[http://www.midwife.org/ACNM/files/ACNMLibraryData/UPLOADFILE\\_NAME/000000000309/ScreeningBriefInterventionPreventAlcoholExposedPregnancyMay2017.pdf](http://www.midwife.org/ACNM/files/ACNMLibraryData/UPLOADFILE_NAME/000000000309/ScreeningBriefInterventionPreventAlcoholExposedPregnancyMay2017.pdf); downloaded on March 26, 2018, showing current information.



### *Perceived Barriers*

In the current sample, the most influential perceived barriers to screening were patient denial/resistance to treatment, time limitations, and patient sensitivity to screening. It is possible that perceived patient denial, resistance, and sensitivity reflect providers' concern about stigmatizing patients (Corrigan et al., 2018; Zizzo and Racine, 2017). Yet previous surveys showed that most pregnant women believe screening for alcohol use is important and do not mind being asked questions about their own use (Jones et al., 2011; Seib et al., 2012). It is reasonable to conclude, based on the relations between knowledge of FASD and screening practice, that the providers' biases and levels of discomfort with these conversations are reflected in their perceptions of their patients' feelings. That same discomfort may lead to unintended increases in the patient discomfort and/or unwillingness to talk about alcohol use (Amaral-Sabadini et al., 2010; McCormick et al., 2006; Moriarty et al., 2012). The respondents shared perceived barriers to screening during pregnancy reported by other providers (Aalto et al., 2001; Anderson et al., 2010; Herzog et al., 2006; Jones et al., 2011; RCM Midwives, 2006; Seib et al., 2012; Wallman et al., 2011; van der Wulp et al., 2013) including misconceptions about the need and futility of asking, as well as lack of knowledge of and/or confidence in screening validity or their ability to screen. It is not surprising that these perceptions influence whether and how primary care providers evaluate their pregnant patients' alcohol use.

Our results show that providers who do not currently use a screening tool are more likely to think that lack of a valid tool is a barrier. Making a valid/reliable tool readily available, effectively implemented for clinical practice, and even conveniently integrated into electronic medical record systems would be an important part of the education process and improvement in healthcare delivery. Such programs are proving effective in enhancing awareness by midwife providers as well as patients (Bazzo et al., 2015). To overcome the barrier of perceived time limitations, it is important to educate midwives and nurses about the existence of brief, easy-to-use, standardized screening tools that have been validated for use with pregnant patients. The current positions of professional organizations recommend screening but do not specify a particular screen for pregnant women (e.g., American College of Nurse-Midwives, 2017; Nurse Practitioners in Women's Health, 2016), although the NPWH statement refers to CDC clinical guidelines that recommend the T-ACE and TWEAK in pregnancy in conjunction with other direct measures of consumption (CDC, 2014).

### *Limitations*

There are limitations in this study. This is a self-selected, highly homogeneous sample with little demographic information. There are approximately 11,000 midwives in the United States (American College of Nurse-Midwives, 2015),

but the ACNM e-mail distribution list included approximately 6,000 members with valid e-mail addresses (personal communication<sup>4</sup>) at the time of the survey. While about half of American midwives were invited to participate, it is not known what characteristics, other than ACNM membership itself, might distinguish members from nonmembers, or what characteristics may distinguish respondents from ACNM members who did not participate. Although self-selection of nurse-midwives suggests the possibility of an intrinsic bias, it is not possible to know the nature of any potential bias or how it may have influenced our current assessments of knowledge, perceptions, or practices regarding FASD. It is possible that providers who are passionate about preventing FASD are more likely to respond. It is just as possible that providers who are convinced that warnings about drinking during pregnancy are alarmist, patronizing, or paternalistic (Armstrong, 2003; Oster, 2013) are more likely to respond. The current survey did not allow assessment of such biases. A final limitation is the possibility that a respondent completed the survey more than once but no unique identifying information was obtained to ensure anonymity.

## CONCLUSIONS

As well known as it is among researchers, public health agencies, and some providers that no amount or timing of alcohol use during pregnancy has been proven safe for a developing fetus (Charness et al., 2016; Green et al., 2016), unacceptable numbers of prenatal care providers remain inadequately informed of the risks of alcohol during pregnancy. Even among providers who are aware of the risks and consequences, providers tend to underestimate the prevalence of FASD in their communities and practices, and too many fail to screen actively for alcohol use (e.g., Goodman and Wolff, 2013). While alcohol-related effects on offspring growth, morphology, physiology, and neurobehavioral outcomes are found with drinking in each trimester of pregnancy, with the specific effects depending on critically sensitive developmental periods when peak exposures occur (e.g., Bailey and Sokol, 2008; Chiodo et al., 2010; Ernhart et al., 1987; Goodlett and Eilers, 1997; Maier and West, 2001), more than a third of the American nurse-midwives who responded to this survey believe alcohol to be safe to fetuses in at least 1 trimester. Given the consensus that no drinking at any time can be considered safe (Charness et al., 2016), misperceptions about there being "safe times" to drink during pregnancy should not influence clinical practice. Providers who reported alcohol use as safe underestimated the prevalence of FASD in the United States, in their community, and among their patients, compromising motivation to screen patients for alcohol use, to educate patients about alcohol's effects, and to encourage abstinence (Floyd et al., 2009). The perceived lack of valid, appropriate, or effective

<sup>4</sup>Personal Communication with ACNM administration.

screening tools and the possible misattribution of discomfort surrounding alcohol use discussion to their pregnant patient are important barriers.

## IMPLICATIONS

The goal of screening for alcohol use during pregnancy is to reduce the frequency and amount of prenatal drinking, and ultimately to reduce the incidence and severity of FASD. Effective screening would identify patients at the highest risk for drinking during pregnancy, or drinking at higher fetal-risk levels, so that education and intervention can be efficiently targeted. Interestingly, some studies have shown that alcohol screening alone, even without follow-up and intervention, can reduce in-pregnancy alcohol use. Screening can serve as an intervention in and of itself. Simply being asked about alcohol use leads some patients to think about and alter their behavior (Floyd et al., 2010; Tzilos et al., 2011). This means that the failure to screen, by any means at any time, compromises the potential for even the simplest intervention. Overcoming the barriers to screening and improving midwives' knowledge about FASD and rates of maternal drinking in their own communities and practices could have a positive impact on birth outcomes and child health and development. Further, when validated screens are used and there is follow-up, brief, targeted, and individualized intervention can be quite effective at reducing in-pregnancy alcohol use (Chang et al., 2005; O'Connor and Whaley, 2007). Care providers can only intervene properly with their patients, or refer to substance abuse specialists, when they have identified who is actually at risk for drinking alcohol during pregnancy. Therefore, screening for alcohol use during pregnancy by primary care providers, including nurse-midwives, is a necessary first step in the primary prevention of FAS and other FASDs.

## CONFLICT OF INTEREST

The authors have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patentlicensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

## REFERENCES

- Aalto M, Pekuri P, Seppä K (2001) Primary health care nurses' and physicians' attitudes, knowledge and beliefs regarding brief intervention for heavy drinkers. *Addiction* 96:305–311.
- ACOG: American College of Obstetricians and Gynecologists (2006) Drinking and reproductive health: a fetal alcohol spectrum disorders prevention tool kit. Washington, DC. Available at: <http://www.acog.org/~media/Departments/Tobacco%20Alcohol%20and%20Substance%20Abuse/FASD%20Clinician%20Guide.pdf?dmc=1&ts=20140204T2305274871>. Accessed August 3, 2015.
- Amaral-Sabadini MB, Saitz R, Souza-Formigoni ML (2010) Do attitudes about unhealthy alcohol and other drug (AOD) use impact primary care professionals' readiness to implement AOD-related preventive care? *Drug Alcohol Rev* 29:655–661.
- American College of Nurse-Midwives (2010) ACNM core data survey. Available at: [http://www.midwife.org/ACNM/files/ccLibraryFiles/Filename/000000001720/CoreDataSurvey\\_2010\\_one-pager.pdf](http://www.midwife.org/ACNM/files/ccLibraryFiles/Filename/000000001720/CoreDataSurvey_2010_one-pager.pdf). Accessed January 30, 2019.
- American College of Nurse-Midwives. (2015) Essential facts about midwives. Available at: <http://www.midwife.org/acnm/files/ccLibraryFiles/Filename/000000005463/EssentialFactsAboutMidwivesJune2015.pdf>. Accessed January 30, 2019.
- American College of Nurse-Midwives (2017) Screening and brief intervention to prevent alcohol-exposed pregnancy. Available at: <http://www.midwife.org/ACNM/files/ACNMLibraryData/UPLOADFILENAME/000000000309/ScreeningBriefInterventionPreventAlcoholExposedPregnancyMay2017.pdf>. Accessed March 26, 2018.
- American College of Nurse-Midwives. Professional resources: ACNM library website. Available at: <http://www.midwife.org/ACNM-Library>. Accessed June 28, 2018.
- American College of Nurse-Midwives. The Arc website. Available at: <http://www.midwife.org/The-Arc>. Accessed June 28, 2018.
- Anderson BL, Dang EP, Floyd RL, Sokol R, Mahoney J, Schulkin J (2010) Knowledge, opinions, and practice patterns of obstetrician-gynecologists regarding their patients' use of alcohol. *J Addict Med* 4:114–121.
- Armstrong EM (2003) *Conceiving Risk, Bearing Responsibility: Fetal Alcohol Syndrome and the Diagnosis of Moral Disorder*. Johns Hopkins University Press, Baltimore, MD.
- Bailey BA, Sokol RJ (2008) Pregnancy and alcohol use: evidence and recommendations for prenatal care. *Clin Obstet Gynecol* 51:436–444.
- Bazzo S, Battistella G, Riscica P, Moino G, Marini F, Bottarel M, Dal Pozzo G, Padovan M (2015) Evaluation of a multilevel and integrated program to raise awareness of the harmful effects of prenatal alcohol exposure in a local community. *Alcohol Alcohol* 50:708–715.
- Cannon MJ, Dominique Y, O'Leary LA, Sniezek JE, Floyd RL (2012) FAS-Net Team. Characteristics and behaviors of mothers who have a child with fetal alcohol syndrome. *Neurotoxicol Teratol* 34:90–95.
- CDC (2015) Alcohol use and binge drinking among women of childbearing age — United States, 2011–2013. *MMWR Morb Mortal Wkly Rep* 64:1042–1046.
- Centers for Disease Control and Prevention (2014) Planning and Implementing Screening and Brief Intervention for Risky Alcohol Use: A Step-by-step Guide for Primary Care Practices. Atlanta, GA: Centers for Disease Control and Prevention, National Center on Birth Defects and Developmental Disabilities, Appendix I, p. 36.
- Chang G (2001) Alcohol-screening instruments for pregnant women. *Alcohol* 25:204–209.
- Chang G, Fisher NDL, Hornstein MD, Jones JA, Orav EJ (2010) Identification of risk drinking women: T-ACE screening tool or the medical record. *J Womens Health* 19:1933–1939.
- Chang G, McNamara TK, Orav EJ (2005) Brief intervention for prenatal alcohol use: a randomized trial. *Obstet Gynecol* 105(5 Pt 1):991–998.
- Charness ME, Riley EP, Sowell ER (2016) Drinking during pregnancy and the developing brain: is any amount safe? *Trends Cogn Sci* 20:80–81.
- Chiodo LM, Delaney-Black V, Sokol RJ, Janisse J, Pardo Y, Hannigan JH (2014) Increased cut-point of the TACER-3 screen reduces false positives without losing sensitivity in predicting risk alcohol drinking in pregnancy. *Alcohol Clin Exp Res* 38:1401–1408.
- Chiodo LM, Sokol RJ, Delaney-Black V, Janisse J, Hannigan JH (2010) Validity of the T-ACE in pregnancy in predicting child outcome and risk drinking. *Alcohol* 44:595–603.
- Corrigan PW, Shah BB, Lara JL, Mitchell KT, Simmes D, Jones KL (2018) Addressing the public health concerns of Fetal Alcohol Spectrum

- Disorder: impact of stigma and health literacy. *Drug Alcohol Depend* 185:266–270.
- Ernhart CB, Sokol RJ, Martier S, Moron P, Nadler D, Ager JW, Wolf A (1987) Alcohol teratogenicity in the human: a detailed assessment of specificity, critical period, and threshold. *Am J Obstet Gynecol* 156:33–39.
- Floyd RL, O'Connor MJ, Bertrand J, Sokol R (2006) Reducing adverse outcomes from prenatal alcohol exposure: a clinical plan of action. *Alcohol Clin Exp Res* 30:1271–1275.
- Floyd RL, Sobell M, Velasquez MM, Ingersoll K, Nettleman M, Sobell L, Dolan Mullen P, Ceperich S, von Sternberg K, Bolton B, Skarpness B, Nagaraja J (2010) Preventing alcohol-exposed pregnancies: a randomized controlled trial. *Am J Prev Med* 32:1–10.
- Floyd RL, Weber MK, Denny C, O'Connor MJ (2009) Prevention of fetal alcohol spectrum disorders. *Dev Disabil Res Rev* 15:193–199.
- Glass L, Ware AL, Mattson SN (2014) Neurobehavioral, neurologic, and neuroimaging characteristics of fetal alcohol spectrum disorders. *Handb Clin Neurol* 125:435–462.
- Goodlett CR, Eilers AT (1997) Alcohol-induced Purkinje cell loss with a single binge exposure in neonatal rats: a stereological study of temporal windows of vulnerability. *Alcohol Clin Exp Res* 21:738–744.
- Goodman DJ, Wolff KB (2013) Screening for substance abuse in women's health: a public health imperative. *J Midwifery Women's Health* 58:278–287.
- Green PP, McKnight-Eily LR, Tan CH, Mejia R, Denny CH (2016) Vital signs: alcohol-exposed pregnancies – United States, 2011–2013. *MMWR Morb Mortal Wkly Rep* 65:91–97.
- Herzig K, Dung H, Gilbert P, Danley DW, Jackson R, Gerbert B (2006) Comparing prenatal providers' approaches to four different risks: alcohol, tobacco, drugs, and domestic violence. *Women Health* 43:83–101.
- Holmqvist M, Nilsen P (2010) Approaches to assessment of alcohol intake during pregnancy in Swedish maternity care: a national-based investigation into midwives' alcohol-related education, knowledge and practice. *Midwifery* 26:430–434.
- Hoyme HE, Kalberg WO, Elliott AJ, Blankenship J, Buckley D, Marais AS, Manning MA, Robinson LK, Adam MP, Abdul-Rahman O, Jewett T, Coles CD, Chambers C, Jones KL, Adnams CM, Shah PE, Riley EP, Charness ME, Warren KR, May PA (2016) Updated clinical guidelines for diagnosing fetal alcohol spectrum disorders. *Pediatrics* 138:e20154256.
- Jones SC, Telenta J, Shorten A, Johnson K (2011) Midwives and pregnant women talk about alcohol: what advice do we give and what do they receive? *Midwifery* 27:489–496.
- Khalil A, O'Brien P (2010) Alcohol and pregnancy. *Obstet Gynaecol Reprod Med* 20:311–313.
- Maier SE, West JR (2001) Drinking patterns and alcohol-related birth defects. *Alcohol Res Health* 25:168–174.
- May PA, Baete A, Russo J, Elliott AJ, Blankenship J, Kalberg WO, Buckley D, Brooks M, Hasken J, Abdul-Rahman O, Adam MP, Robinson LK, Manning M, Hoyme HE (2014) Prevalence and characteristics of fetal alcohol spectrum disorders. *Pediatrics* 134:855–866.
- May PA, Blankenship J, Marais AS, Gossage JP, Kalberg WO, Barnard R, De Vries M, Robinson LK, Adnams CM, Buckley D, Manning M, Jones KL, Parry C, Hoyme HE, Seedat S (2013) Approaching the prevalence of the full spectrum of fetal alcohol spectrum disorders in a South African population-based study. *Alcohol Clin Exp Res* 37:818–830.
- May PA, Chambers CD, Kalberg WO, Zellner J, Feldman H, Buckley D, Kopald D, Hasken JM, Xu R, Honerkamp-Smith G, Taras H, Manning MA, Robinson LK, Adam MP, Abdul-Rahman O, Vaux K, Jewett T, Elliott AJ, Kable JA, Akshoomoff N, Falk D, Arroyo JA, Hereld D, Riley EP, Charness ME, Coles CD, Warren KR, Jones KL, Hoyme HE (2018) Prevalence of fetal alcohol spectrum disorders in 4 US communities. *JAMA* 319:474–482.
- May PA, Fiorentino D, Coriale G, Kalberg WO, Hoyme HE, Aragón AS, Buckley D, Stellavato C, Gossage JP, Robinson LK, Jones KL, Manning M, Ceccanti M (2011) Prevalence of children with severe fetal alcohol spectrum disorders in communities near Rome, Italy: new estimated rates are higher than previous estimates. *Int J Environ Res Public Health* 8:2331–2351.
- May PA, Gossage JP, Kalberg WO, Robinson LK, Buckley D, Manning M, Hoyme HE (2009) Prevalence and epidemiologic characteristics of FASD from various research methods with an emphasis on recent in-school studies. *Dev Disabil Res Rev* 15:176–192.
- McCormick KA, Cochran NE, Back AL, Merrill JO, Williams EC, Bradley KA (2006) How primary care providers talk to patients about alcohol: a qualitative study. *J Gen Intern Med* 21:966–972.
- Mehta C, Masson G, Iqbal Z, O'Mahony F, Khalid R (2009) Prevalence of excessive alcohol consumption in pregnancy. *Public Health* 123:630–631.
- Mengel MB, Searight HR, Cook K (2006) Preventing alcohol-exposed pregnancies. *J Am Board Fam Med* 19:494–505.
- Moriarty HJ, Stubbe MH, Chen L, Tester RM, Macdonald LM, Dowell AC, Dew KP (2012) Challenges to alcohol and other drug discussions in the general practice consultation. *Fam Pract* 29:213–222.
- Nurse Practitioners in Women's Health (2016) Position statement: Prevention of alcohol-exposed pregnancies. Available at: <https://npwomenshealthcare.com/prevention-alcohol-exposed-pregnancies/> Published November 2016. Accessed March 26, 2018.
- O'Connor M, Whaley S (2007) Brief intervention for alcohol use by pregnant women. *Am J Public Health* 97:252–259.
- Ondersma SJ, Svikis DS, LeBreton JM, Streiner DL, Grekin ER, Lam PK, Connors-Burge V (2012) Development and preliminary validation of an indirect screener for drug use in the perinatal period. *Addiction* 107:2099–2106.
- Oster E (2013) *Expecting Better: Why the Conventional Pregnancy Wisdom is Wrong—and What You Really Need to Know*. Penguin Press, New York, NY.
- Paley B, O'Connor MJ, Frankel F, Marquardt R (2006) Predictors of stress in parents of children with fetal alcohol spectrum disorders. *J Dev Behav Pediatr* 27:396–404.
- Panczakiewicz AL, Glass L, Coles CD, Kable JA, Sowell ER, Wozniak JR, Jones KL, Riley EP, Mattson SN, CIFASD (2016) Neurobehavioral deficits consistent across age and sex in youth with prenatal alcohol exposure. *Alcohol Clin Exp Res* 40:1971–1981.
- Parker SE, Mai CT, Canfield MA, Rickard R, Wang Y, Meyer RE, Anderson P, Mason CA, Collins JS, Kirby RS, Correa A (2010) Updated national birth prevalence estimates for selected birth defects in the United States, 2004–2006. *Birth Defects Res A Clin Mol Teratol* 88:1008–1016.
- Payne JM, Watkins RE, Jones HM, Reibel T, Mutch R, Wilkins A, Whitlock J, Bower C (2014) Midwives' knowledge, attitudes and practice about alcohol exposure and the risk of fetal alcohol spectrum disorder. *BMC Pregnancy Childbirth* 14:377.
- Popova S, Lange S, Probst C, Gmel G, Rehm J (2017a) Estimation of national, regional, and global prevalence of alcohol use during pregnancy and fetal alcohol syndrome: a systematic review and meta-analysis. *Lancet Glob Health* 5:e290–e299.
- Popova S, Lange S, Probst C, Parunashvili N, Rehm J (2017b) Prevalence of alcohol consumption during pregnancy and fetal alcohol spectrum Disorders among the general and Aboriginal populations in Canada and the United States. *Eur J Med Genet* 60:32–48.
- Popova S, Lange S, Probst C, Gmel G, Rehm J (2018) Global prevalence of alcohol use and binge drinking during pregnancy and fetal alcohol spectrum disorder. *Biochem Cell Biol* 96:237–240.
- Popova S, Stade B, Bekmuradov D, Lange S, Rehm J (2011) What do we know about the economic impact of fetal alcohol spectrum disorder? A systematic literature review *Alcohol Alcohol* 46:490–497.
- Roozen S, Peters GJ, Kok G, Townend D, Nijhuis J, Curfs L (2016) Worldwide prevalence of fetal alcohol spectrum disorders: a systematic literature review including meta-analysis. *Alcohol Clin Exp Res* 40:18–32. Erratum in: *Alcohol Clin Exp Res*. 40:1587.
- Royal College of Midwives (2006) Should midwives advise women to avoid alcohol completely during pregnancy? *Midwives* 9:318.
- Russell M (1994) New assessment tools for risk drinking during pregnancy. *Alcohol Health Res World* 18:55–61.
- Russell M, Martier S, Sokol R, Mudar P, Bottoms S, Jacobson S, Jacobson J (1994) Screening for pregnancy risk-drinking. *Alcohol Clin Exp Res* 18:1156–1161.

- Sampson PD, Streissguth AP, Bookstein FL, Little RE, Clarren SK, Dehaene P, Hanson JW, Graham JM Jr (1997) Incidence of fetal alcohol syndrome and prevalence of alcohol-related neurodevelopmental disorder. *Teratology* 56:317–326.
- Seib CA, Daghli M, Heath R, Booker C, Reid C, Fraser J (2012) Screening for alcohol and drug use in pregnancy. *Midwifery* 28:760–764.
- Sipe TA, Fullerton JT, Schuiling KD (2009) Demographic profiles of certified nurse-midwives, certified registered nurse anesthetists, and nurse practitioners: reflections on implications for uniform education and regulation. *J Prof Nurs* 25:178–185.
- Smith L, Savory J, Couves J, Burns E (2014) Alcohol consumption during pregnancy: cross-sectional survey. *Midwifery* 30:1173–1178.
- Sokol RJ, Martier SS, Ager JW (1989) The T-ACE questions: practical prenatal detection of risk-drinking. *Am J Obstet Gynecol* 160:863–868.
- Stade B, Ali A, Bennett D, Campbell D, Johnston M, Lens C, Tran S, Koren G (2009) The burden of prenatal exposure to alcohol: revised measurement of cost. *Can J Clin Pharmacol* 16:e91–e102.
- Stade B, Ungar WJ, Stevens B, Beyene J, Koren G (2006) The burden of prenatal exposure to alcohol: measurement of cost. *J FAS Int* 4:e5.
- Stade B, Ungar WJ, Stevens B, Beyene J, Koren G (2007) Cost of fetal alcohol syndrome disorder in Canada. *Can Fam Physician* 53:1303–1304.
- Substance Abuse and Mental Health Services Administration (SAMHSA) (2006) Fetal alcohol spectrum disorders by the numbers. Fetal Alcohol Spectrum Disorders Center for Excellence website. Available at: [http://fasdcenter.samhsa.gov/documents/WYNK\\_Numbers.pdf](http://fasdcenter.samhsa.gov/documents/WYNK_Numbers.pdf). January 2006. Accessed June 28, 2018.
- Substance Abuse and Mental Health Services Administration (SAMHSA) (2014) Results from the 2013 National Survey on Drug Use and Health: summary of national findings. Rockville, MD. NSDUH Series H-48, HHS Publication No. (SMA) 14-4863. Available at: <http://www.samhsa.gov/data/sites/default/files/NSDUHresultsPDFWHTML2013/Web/NSDUHresults2013.pdf>
- Tzilos GK, Sokol RJ, Ondersma SJ (2011) A randomized phase 1 trial of a brief computer-delivered intervention for alcohol use during pregnancy. *J Womens Health* 20:1517–1524.
- van der Wulp NY, Hoving C, de Vries H (2013) A qualitative investigation of alcohol use advice during pregnancy: experiences of Dutch midwives, pregnant women and their partners. *Midwifery* 29:e89–e98.
- Volk RJ, Cantor SB, Steinbauer JR, Cass AR (1997) Item bias in the CAGE screening test for alcohol use disorders. *J Gen Intern Med* 12:763–769.
- Wallman CM, Smith PB, Moore K (2011) Implementing a perinatal substance abuse screening tool. *Adv Neonatal Care* 11:255–267.
- Warren KR, Hewitt BG, Thomas JD (2011) Fetal alcohol spectrum disorders: research challenges and opportunities. *Alcohol Res Health* 34:4–14.
- Watkins RE, Payne JM, Reibel T, Jones HM, Wilkins A, Mutch R, Bower C (2015) Development of a scale to evaluate midwives' beliefs about assessing alcohol use during pregnancy. *BMC Pregnancy Childbirth* 15:353.
- Zizzo N, Racine E (2017) Ethical challenges in FASD prevention: scientific uncertainty, stigma, and respect for women's autonomy. *Can J Public Health* 108:e414–e417.