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Older Not Wiser: Risk of Prenatal Alcohol Use by Maternal Age

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Abstract High levels of alcohol use among pregnant women have been associated with a spectrum of birth defects. Greater maternal age has been related to an increased risk of drinking during pregnancy. Although the context, process, and outcomes of pregnancy and alcohol use vary by maternal age, no studies have examined predictors of prenatal drinking by age. This study addresses this gap by examining potential risk factors associated with prenatal alcohol use (any versus none) by maternal age (<20, 20–25, 26–34, and 35 years or older). Descriptive and logistic regression analyses were completed on survey data from 9,004 pregnant women from the north central U.S. Descriptive statistics revealed teens in general had a higher level or greater occurrence of risk factors previously identified with prenatal drinking compared to older women, yet women of advanced maternal age (35 years or older) were most likely to drink alcohol during pregnancy. Based on the regression by age, 20–25 year old women had the greatest number of significant risk factors associated with prenatal drinking including being employed, white, unmarried, first birth, smoking prenatally, greater levels of depressed mood, and more experiences related to alcohol abuse. The number and patterns of significant predictors of drinking alcohol while pregnant by age encourage greater investigation of other social, contextual factors that might contribute to the risk of prenatal drinking. This is especially salient for women of advanced maternal age, for whom very few significant predictors emerged.

Keywords Pregnancy · Alcohol use · Maternal age · Prenatal drinking

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Introduction

Alcohol exposed pregnancies can result in fetal alcohol spectrum disorder (FASD), of which fetal alcohol syndrome (FAS) is the most severe diagnosis. The FAS prevalence estimates vary widely from 1 to 49 per 10,000 children [1, 2], and FASD rates are estimated to be three times that of FAS [3]. The average annual medical expenditures for a child with FAS on Medicaid ($16,782.00) is nine times that for a comparable child without FAS ($1859.00) [4]. Although FASD can be prevented by avoiding alcohol during pregnancy, [5], national data have revealed that 12.2% [6] to 23% [7] of all live births are associated with an alcohol-exposed pregnancy.

The risk of drinking while pregnant is likely to vary by maternal age. In general, younger women are more likely to drink [8], binge drink (8.6%) [9], and face a greater risk of meeting the DSM-IV criteria for alcohol abuse [10] than older women. Younger women's pregnancies, particularly teens', are more likely to be unintentional [11, 12] and recognized later, increasing the risk of prenatal drinking [11–13]. Despite these data, older age is associated with an increased risk of alcohol use during pregnancy [13–16].

The importance of examining the timing of events such as pregnancy by age is also emphasized by life course theory. The normative timing of pregnancy in the U.S. is for women ages 20–34; over 75% of all births occur to women in this age group [17]. Life course theory argues that off-time events can be more stressful than those that are normative in their timing [18]. Indeed, given issues such as maturation and aging, social structure, and cultural norms [19, 20], pregnancy as an off-time event, is more stressful for teens [21] and women of advanced maternal age than for women ages 20–34 [22].

Beyond age, the risk of prenatal alcohol use is heightened by a number of demographic and contextual variables. White and non-Hispanic women have greater risk of prenatal alcohol use [7, 14, 23]. Older U.S. women are more likely to be white, non-Hispanic than younger women [24]. Employment also is related to an increased risk of prenatal drinking [14, 16]. Based on 2011 data, the employment of women increases with age, with nearly 70% of women, ages 25–44, being employed [25].

Marriage typically is related to a reduced risk of drinking during pregnancy [16, 26]. In general, older women are more likely to be married [27]. This trend also may hold true for pregnant women [28]. First born births are also at greater risk of prenatal alcohol exposure than subsequent births [7, 14], with younger women being more likely to be pregnant with their first child than older women.

In general better health reduces the risk of prenatal drinking [29]. Smoking [7, 13, 16, 30, 31] and higher levels of depressed mood [16, 32] enhance pregnant women's risk of alcohol use. For women the risk of depression increases with age [33], whereas women who smoke prenatally are more likely to be younger than non-smokers [34, 35].

Physical and sexual abuse increase the risk of prenatal alcohol use for both for adolescents [31, 36] and older women [37]. Women with a history of sexual abuse are more likely than their counterparts to report unplanned pregnancies, increasing their risk of prenatal alcohol use [38]. Sexual and physical abuse also increases the risk of teen pregnancy [39], thus pregnant teens are more likely to have experienced abuse than their non-pregnant counterparts [40].

Finally, women who reported issues related to alcohol misuse (e.g., can't remember things that have happened while drinking or been asked to drink less by friend or family member) are more apt to drink prenatally [7, 16]. Overall, younger women are more likely to misuse alcohol than older women [10].

In sum, the occurrence of prenatal drinking and related risk factors are likely to vary by age. This study specifically examines variation in prenatal alcohol use and patterns of related risk factors by age: less than 20 years, 20–25, 26–34, and 35 and older. The youngest and oldest age groups are based on typical age groupings associated with pregnancy [17]. The 20–25 age group represents the developmental period of emerging adulthood [41]. Based on previous studies, it is anticipated that older women will report a greater prevalence of prenatal drinking and more frequently present the risk characteristics of being white, employed, less healthy, and greater depressed mood than their younger counterparts. Compared to women of normative childbearing years (20–34), pregnant teens are expected to report more alcohol misuse, be single, be pregnant with first born, smoke, and present higher risk levels of physical and sexual abuse. These findings should contribute to the development of age appropriate prevention efforts.

Materials and Method

Design

Prior to data collection, human subjects' approval was secured from the four universities associated with this project. All data were collected between July 2001 and May 2003 in private and community-based clinics offering prenatal care in four Midwestern states using a stratified sampling technique [42]. At their first prenatal visit, the intake nurse or receptionist told the participants about the research project. If interested, the pregnant woman received a packet with the survey and a self-addressed envelope. She read the general information sheet and instructions, completed the survey, and returned it in the sealed self-addressed envelope. The receptionist then gave the participant an incentive for a local purchase (e.g., a $5 gift card). The survey is the prenatal questionnaire (PQN) [42], whose core questions were taken from the substance abuse questionnaire (SAQ), which has been tested with the Native American and Caucasian population. In detecting prenatal drinking, the SAQ's sensitivity was 76.6%, its specificity 92.8%, and its predictive value positive was 92.4% [43].

Sample

A total of 10,014 women participated in the overall study. This particular study's sample includes 9,004 women with complete data (89.9%).

Measures

Prenatal Alcohol Use

This outcome was based on the number of months pregnant (calculated from date of last normal menstrual cycle and

survey completion date) and the woman's response to the question, "When was your last drink of alcohol?" The response options were: *within the last week*, *within the last month*, *within the last year* (*the number of months ago*), *more than a year ago*, and *I have never drank*. The final dichotomous outcome identified women who apparently drank prenatally (i.e., pregnancy date was earlier than date of last drink) and those who never drank or stopped before pregnancy [16, 43, 45].

Demographic Measures

Age was provided in years. White referred to the self-identified race of the respondent (1 = *white*; 0 = *other or no race indicated*). Employed identified if women were employed on the survey date (1 = *employed*; 0 = *not employed*). For the married/cohabitating measure, 1 = *married or cohabitating* and 0 = *any other status*. Finally, first birth was based on the question. "How many children have you had?" (1 = *0 children*; 0 = *1 or more children*).

Health Measures

Perceptions of general health ranged from 1 = *poor* to 5 = *excellent*. Depressed mood was based on the question, "In the last month, have you felt so sad, discouraged, hopeless, or had so many problems that you have wondered if everything was worthwhile" (1 = *Not at all* to 6 = *Extremely so—to the point that I have just about given up*) [16, 44].

The violence exposure composite was based on three dichotomous items: (1) "Has anyone physically abused (hit, kicked, slapped etc.…) you during the last year?" (2) "Has anyone physically abused (hit, kicked, slapped etc.…) you during this pregnancy?" And (3) "Have you ever had sex without giving your consent?" (1 = *Yes* and 0 = *No*). A sum score was then created with 0 indicating *no reported abuse experiences* and 3 means that *all three measures were reported*. Prenatal smoking was based on the question, "Do you smoke?" (1 = *yes* and 0 = *no*) [16, 42, 44].

Alcohol Related Risk Measures

The alcohol related risks included five questions (1 = *yes* and 0 = *no*): (1) "Do you ever feel that you have an alcohol problem?"; (2) "Do you ever feel that you should cut down on your drinking?"; (3) "Has a friend or family member ever told you about things you said or did while you were drinking that you could not remember?"; (4) "Has a friend or family member ever asked you to drink less?"; and (5) "Do you feel you could use treatment at the present time?" [16, 42–44]. The alcohol related risk scale was the sum of these measures and ranged from 0 to 5 [16].

Plan of Analyses

First power analyses using G*Power 3.1 were conducted to ensure the sample size was adequate for detecting statistical significance. For each statistical test examined (χ^2, ANOVA, and regression), an adequate level of power was set at .95 and α_{err} at .05.

To examine the sample's descriptive characteristics, frequencies of the categorical measures and means and standard deviations for the continuous measures were used. To determine differences between persons with complete and incomplete data, χ^2 and t tests tested significant group differences in the categorical and continuous measures respectively.

Descriptive analyses were conducted to examine age group differences in the occurrence of prenatal drinking and the various risk factors. χ^2 tested the categorical measures' occurrence by age group. Mean level differences in the continuous measures by age group were tested with ANOVA; if significant this was followed by a Tukey test to determine significant contrasts. Finally, two logistic regression models were conducted to examine patterns of prenatal drinking predictors by age group. The first model included demographics, health, and alcohol related risk scale. In order to further examine the predictive patterns of the individual measures included in the alcohol related risk scale, the second model included the demographic, health, and five individual alcohol related risk measures. A significance level of $p < .05$ was used for all statistical tests.

Results

Sample Characteristics

The 9,004 women resided in Minnesota ($n = 4{,}610$), Montana ($n = 1{,}318$), North Dakota ($n = 1{,}576$), and South Dakota ($n = 1{,}500$). Notably, these four states have some of the highest binge drinking rates for women, ages 18–44 [8]. Drinking while pregnant was lowest for the women of North Dakota (19.8%) and highest for Minnesota women (23.6%) compared to women of Montana (20.9%) and South Dakota (20.6%; $\chi^2 = 13.54$; $p < .01$).

The participants' ages ranged from 14 to 48 ($M = 27.2$; SD = 5.7). The majority of the women were white (87.0%). Other racial and ethnic groups included Native American (4.6%), Asian/Pacific Islander (1.9%), Black (1.9%), multiracial (1.7%) and other or unknown (2.9%). Of the women, 71.6% were employed and 80.9% were married or cohabitating. The number of children ranged

from 0 to 15 ($M = .97$). Regarding health, the mean level of general health was 3.80 (SD = .75), violence exposure was .15 (SD = .44), and depressed mood was 1.70 (SD = 1.04). Of the participants, 17.2% shared that they smoked during their pregnancy. The alcohol related risk scale mean was .23 (SD = .68), with 1,466 women (16.3%) reporting one or more risk.

Complete Versus Missing Data Case Analysis

Chi-square analysis revealed that the sample with missing data had a greater proportion of women who were not married/cohabitating and asked to drink less. The study participants were more likely to have used alcohol prenatally, and be white, pregnant with first born, and employed. *t* test analysis revealed that the study sample had better general health, and lower levels of depressed mood. In sum the study sample had a greater proportion of prenatal drinkers, but a lower risk for five of the seven significant risk factors.

Power Analysis

G*Power [45] was used to conduct post hoc statistical power analysis for a multiple regression with 13 predictors by age group. The observed power by age group exceeded .90, indicating sufficient statistical power. Note, the post hoc power calculation assumes that the sample characteristics are equal to those of the associated population—an unconfirmed assumption.

Descriptive Analyses

Chi-square analysis was conducted on 13 bivariate measures by age group (see Table 1). The proportion of pregnant women who drank, were white, and married/cohabitating increased with age, whereas the proportion pregnant with their firstborn decreased with age. The teen group was most likely to have experienced physical abuse in the past year and while pregnant, sex without consent, and three of the five alcohol related risk factors (i.e., feel

Table 1 Comparison of pregnant women characteristics by age group, 2001–2003

	<20 years ($n = 799$) Number (%)	Ages 20–25 ($n = 2,853$) Number (%)	Ages 26–34 ($n = 4,329$) Number (%)	35 years or older ($n = 1,023$) Number (%)	*p* value
Distribution comparisons					
Prenatal alcohol use	127 (15.9)	634 (22.2)	958 (22.1)	264 (25.8)	.00
White	576 (71.0)	2389 (83.7)	3933 (90.9)	941 (92.0)	.00
Employed	356 (44.6)	1982 (69.5)	3346 (77.3)	766 (74.9)	.00
Married	301 (37.7)	2055 (72.0)	3974 (91.8)	958 (93.6)	.00
First birth	668 (83.6)	1472 (51.6)	1413 (32.6)	221 (21.6)	.00
Prenatal smoking	261 (32.7)	695 (24.4)	479 (11.1)	118 (11.5)	.00
Phys. Abuse in past year	92 (11.7)	175 (6.1)	75 (1.7)	23 (2.2)	.00
Phys. Abuse while pregnant	40 (5.0)	58 (2.0)	27 (.6)	5 (.5)	.00
Sex without consent	117 (14.6)	315 (11.0)	328 (7.6)	84 (8.2)	.00
Feel you have alcohol problem	23 (2.9)	55 (1.9)	70 (1.6)	21 (2.1)	.10
Feel you should cut down drinking	73 (9.1)	173 (6.1)	200 (4.6)	62 (6.1)	.00
Forget actions while drinking	133 (16.6)	391 (13.7)	577 (13.3)	94 (9.2)	.00
Asked to drink less	62 (7.8)	140 (4.9)	120 (2.8)	31 (3.0)	.00
Could use treatment now	3 (.4)	15 (.5)	12 (.3)	3 (.3)	.38

	<20 years ($n = 799$) Mean (sd)	20–25 ($n = 2,853$) Mean (sd)	26–34 ($n = 4,329$) Mean (sd)	>35 ($n = 1,023$) Mean (sd)	*F*	Contrasts
Mean comparisons						
General health	3.52 (.76)	3.66 (.74)	3.90 (.72)	3.96 (.76)	110.72***	4 > 3 >2 > 1
Depressed mood	2.24 (1.25)	1.84 (1.12)	1.54 (.92)	1.54 (.93)	139.28***	1 > 2 > 3,4
Violence exposure scale	.31 (.64)	.19 (.51)	.10 (.34)	.11 (.37)	68.42***	1 > 2 > 3,4
Alcohol related risk scale	.37 (.81)	.27 (.72)	.23 (.63)	.21 (.64)	12.23***	1 > 2 > 3,4

$N = 9,004$

*** $p < .001$

you should cut down, forget while drinking, and asked to drink less).

ANOVA revealed that the five continuous measures differed significantly by age group. Teens reported greater mean levels of risk than the other age groups: lower levels of general health and higher levels of depressed mood, violence exposure, and alcohol related risks. The risk levels for these four factors decreased with age.

Logistic Regression Models

Two logistic regression models by age group tested the significance of the relation between various risk factors and prenatal alcohol use. The first regression model included demographic, health, and the alcohol related risk scale regressed on prenatal drinking. The second model explored the independent contributions of the alcohol related risk items, in lieu of the alcohol related risk scale.

The first model (see Table 2) was significant for all age groups. Being white and unmarried was associated with an increased risk of prenatal drinking for the 20–25 year old pregnant women. Employment was significantly related to a greater risk of prenatal drinking for the 20–25 and 26–34 year old age groups. Being pregnant with a firstborn child was related to greater risk of prenatal drinking for all four age groups. Depressed mood was related to an 11% greater risk of prenatal drinking for women, ages 20–25. The alcohol related risk scale was significant for all four age groups, associated with an increased risk of prenatal drinking by 47–79%.

The second model explored the relation between prenatal drinking and the items of the alcohol related risk scale above and beyond the demographic and health factors (see Table 3). This model was also significant for all age groups.

The significance of the demographic and health related factors were similar to those of the first regression model. However, different patterns of significant alcohol risk factors emerged by age group. Women, ages 20–25 and 26–34, reported the greatest number (2 of 5) of significant predictors. For these two groups, feeling one should cut down on their drinking was significantly associated with an increased risk of alcohol use during pregnancy—138–184% respectively. For the three younger groups, forgetting things done while drinking was significantly related to a greater risk of prenatal drinking risk (85–140%). No alcohol related risk items were significant for the oldest women.

Discussion

In examining prenatal drinking across women during their reproductive years, greater maternal age has been a significant risk factor [44]. Yet our understanding of how patterns of prenatal drinking risk factors may differ between age groups is limited. This study addresses this research gap. An enhanced understanding of how prenatal alcohol risk factors differ by maternal age may assist to more accurately identify high risk situations and develop age appropriate intervention content and strategies.

In keeping with most previous research, older women were more likely to drink prenatally than the younger women [13–16]. Yet teens had the highest risk levels or occurrences for 14 of the 17 previously identified risk measures. Thus, the compelling trend revealed is that in

Table 2 Logistic regression, odds ratios (confidence intervals), predictors of prenatal drinking by maternal age, $n_{<20} = 799$; $n_{20–25} = 2{,}853$; $n_{26–34} = 4{,}329$; $n_{>34} = 1{,}023$

Factor	Less than 20	20–25 years	26–34 years	35 or older
White (1) versus Other (0)	1.38 (1.14–1.62)	1.62** (1.48–1.76)	1.07 (.93–1.21)	1.32 (1.03–1.61)
Employed	1.17 (.96–1.68)	1.50*** (1.39–1.61)	1.45*** (1.35–1.55)	1.21 (1.03–1.39)
Married	.76 (.54–.98)	.74** (.63–.85)	.83 (.69–.97)	1.07 (.76–1.38)
First birth	2.18* (1.83–2.53)	1.50*** (1.40–1.60)	1.43*** (1.35–1.49)	1.70** (1.53–1.87)
General health	.91 (.74–1.05)	.96 (.89–1.03)	1.02 (.96–1.08)	1.15 (1.05–1.25)
Violence exposure	1.06 (.91–1.21)	.95 (.86–1.04)	1.07 (.96–1.18)	1.12 (.92–1.32)
Depressed mood	1.08 (1.00–1.16)	1.11* (1.07–1.15)	1.07 (1.03–1.11)	1.13 (1.05–1.21)
Prenatal smoking	1.24 (1.14–1.38)	1.45** (1.34–1.56)	1.16 (1.03–1.29)	1.20 (.96–1.44)
Alcohol related risks	1.47*** (1.37–1.57)	1.49*** (1.43–1.55)	1.79*** (1.73–1.85)	1.51*** (1.40–1.62)
Model χ^2	34.06***	155.99***	192.20***	37.81***
Model R^2	.04	.05	.04	.04
Nagelkerke R^2	.07	.08	.07	.05

*** $p < .001$; ** $p < .01$; * $p < .05$

Table 3 Logistic regression, odds ratios (confidence intervals), predictors of prenatal drinking by maternal age, $n_{<20} = 799$; $n_{20–25} = 2{,}853$; $n_{26–34} = 4{,}329$; $n_{>34} = 1{,}023$

Factor	Less than 20 years	20–25 years	26–34 years	35 years or older
White (1) vs. Other (0)	1.35 (1.10–1.60)	1.67*** (1.52–1.72)	1.07 (.93–1.21)	1.34 (1.05–1.62)
Employed	1.17 (.96–1.38)	1.49*** (1.38–1.60)	1.44*** (1.34–1.54)	1.20 (1.02–1.38)
Married	.74 (.52–.96)	.75** (.64–.86)	.84 (.70–.98)	1.07 (.76–1.38)
First birth	2.21* (1.85–2.57)	1.48*** (1.38–.1.58)	1.39*** (1.31–1.47)	1.69** (1.52–.1.86)
General health	.91 (.77–1.05)	.96 (.89–1.03)	1.02 (.96–1.08)	1.15 (1.05–1.25)
Violence exposure	1.06 (.91–1.21)	.97 (.88–1.09)	1.11 (1.00–1.22)	1.16 (1.08–1.24)
Depressed mood	1.08 (1.00–1.16)	1.11* (1.07–1.15)	1.06 (1.02–1.10)	1.13 (1.05–1.21)
Prenatal smoking	1.24 (1.03–1.45)	1.46** (1.55–1.51)	1.19 (1.07–1.31)	1.24 (1.00–1.48)
Feel have alcohol problem	1.34 (.77–1.91)	.51 (.15–.87)	.86 (.55–1.17)	1.30 (.73–1.87)
Feel should cut down	1.11 (.75–1.45)	2.38*** (2.17–2.59)	2.84*** (2.66–3.02)	1.77 (1.43–2.11)
Did things while drinking that couldn't remember	2.40** (2.14–2.66)	1.85*** (1.72–1.98)	2.28*** (2.17–2.39)	1.55 (1.29–1.81)
Asked to drink less	1.00 (.61–1.39)	1.13 (.90–1.36)	.87 (.63–1.11)	1.44 (.94–1.94)
Feel could use treatment now	2.64 (1.21–4.03)	1.34 (.76–1.94)	2.16 (1.50–2.82)	.40 (-.94–1.74)
Model χ^2	38.37***	171.65***	215.89***	39.09***
Model R^2	.05	.06	.05	.04
Nagelkerke R^2	.08	.09	.08	.06

*** $p < .001$; ** $p < .01$; * $p < .05$

general the prevalence of the examined risk factors decreases with age, while the proportion of women using alcohol during their pregnancy increases with age.

Life course theory [46] may help in interpreting the contradiction in the prevalence of risk factors and occurrence of prenatal drinking by age. In keeping with this theory, pregnancies of teens or women aged 35 or older would be off-time and more stressful than normative timing (i.e., pregnancies at ages 20–34). Indeed, older women are more likely than their younger adult counterparts to have more stressful pregnancies [47], including greater maternal anxiety [48], placental complications, diabetes, and pregnancy induced hypertension [49]. Adolescent women at high risk of pregnancy also have reported higher stress levels than their low risk peers [50]. With stress, older women may legitimize their drinking as a coping mechanism. Due to legal constrictions, pregnant teens would have less access to alcohol as a coping mechanism.

Life course theory also emphasizes the importance of historical and social context for developmental outcomes. The minimum legal drinking age may present one such contextual aspect. With the minimum legal drinking age of 21, teen alcohol use is a status offense, reducing access and availability of alcohol to minors. However, Minnesota, Montana, and South Dakota's minimum legal drinking age was 19 until 1986, 1987, and 1988, respectively. Therefore, except for North Dakota residents, women 35 years or older at the time of this study were able to drink legally 2 years earlier than the women of the three younger groups. Interestingly, North Dakota women presented the lowest prenatal drinking risk of the four states. However, survey measures do not permit exploring the contribution of earlier legal initiation of alcohol use or the unique social and maturational differences between the age groups. These questions remain for future studies.

For the general population, women's depression increases with age and the quality of general health decreases with age; these trends did not emerge for the pregnant study participants. Instead pregnant teens reported the highest levels of depressed mood and poorest general health of the four age groups. As an off-time event, teen pregnancy is commonly correlated with other behaviors that may contribute to poor physical and mental health, including illegal substance use, alcohol use, low family income and education [51], and childhood sexual abuse [52]. This tendency may contribute to the pregnant adolescents' less favorable health characteristics.

Many of the risk factors followed trends supported by previous studies. First birth was the only significant factor for women 35 and older in the second model. In keeping with previous research [7, 14]; first born births were related to a reduced risk of prenatal alcohol use. Marriage also was significantly associated with a reduced risk of prenatal drinking as expected.

Adolescents reported greater likelihood of being unmarried, experiencing the risk of physical abuse in the past year and during this pregnancy, greater occurrence of alcohol related risks, and prenatal smoking. Yet these measures were not significant factors of teens' risk of prenatal drinking. Given that adolescent pregnancy and

prenatal alcohol use are both non-normative events that compromise health, perhaps it is not surprising that they share many common risk factors, including alcohol related risks, smoking [53], depressed mood [54, 55], and abuse [52]. So although the adolescent women report greater levels of risks associated with prenatal drinking compared to older women, these attributes may simply reflect the traditional characteristics of pregnant adolescents.

Compared to younger women, predominate prenatal drinking risks of past research appear less relevant for women 35 years or older. Increased pregnancy occurrence for women of advanced maternal age [22] and indications that effects of in utero alcohol exposure is more severe for children born to older mothers [56], warrant further investigation of the prenatal drinking risk factors for this age group.

Limitations

Some precautions must be noted when reviewing these findings, including issues of measurement, design, and external validity. First, the survey measures are limited in number and scope. Although the survey measures are quite typical when examining prenatal alcohol use, very few of these measures were significant predictors of prenatal alcohol use for women, ages 35 and older. Qualitative studies could help identify more relevant factors.

Second, some of the survey measures are not optimal. For example, a single item was used as a measure of depressed mood. This is not a valid measure of depression nor should it be interpreted as such. Future studies could include a greater number of validated factor scales as opposed to single item measures. However, given the nature of the study, brevity was important.

Third, the cross-sectional design of the study does not allow for assumptions about causality. Although the independent variables have been analyzed as factors of prenatal drinking, the sequencing of events is uncertain and may be bidirectional.

Fourth, the study sample differed from persons with incomplete data. Although the study sample had lower risk of alcohol use during pregnancy, the persons with incomplete data presented higher risk levels in relation to five of the seven significant risk factors. Note, this comparative analysis was not conducted by age. These differences caution the extrapolation of the findings beyond those participants with complete data.

Fifth, the available outcome was calculated prenatal drinking based on length of pregnancy and timing of last alcoholic drink. This measure did not allow us to address the level of prenatal drinking that occurred. Patterns and frequency of prenatal drinking are important, particularly in estimating the fetus' risk of FASD.

Finally, although the Minnesota data are quite reflective of the state [16], the sampling procedure does not accommodate the generalization of the results to the larger population of the four states from whence the data were drawn. These four states also in no way represent the greater U.S., as the populations of these states are predominately white and noted as having some of the highest prenatal drinking rates in the nation [9].

Conclusion

This study's examination of prenatal drinking by age provides greater insight into the mechanisms associated with prenatal drinking. The different patterns of significant risk factors by age indicate that their contribution to our understanding of prenatal drinking is not consistent across age groups. The typical demographic and psychosocial factors included in the regression models most strongly spoke to the circumstances of pregnant women between 20 and 34, who accounted for the greatest proportion of pregnancies in the sample (80%). Thus, prevention strategies that address these significant factors should reduce the risk of prenatal alcohol use for the majority of pregnancies.

The salient findings that pregnant teens were more likely to have concerns about their drinking and report the need to cut down and women 35 years or older were more likely to drink prenatally than their younger counterparts cannot be easily dismissed. Age specific models and prevention efforts could provide a more promising approach in reducing the threat of drinking during pregnancy. Given the personal, societal, and economic ramifications, this prevention opportunity should be pursued with vigor.

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