Maternal and Child Health Journal
https://doi.org/10.1007/s10995-021-03127-1

Improved Maternal and Infant Outcomes with Serial, Self-Reported Early Prenatal Substance Use Screening

Stacy L. BODEN[1] · **Cresta W. JONES**[2] · **Erwin T. CABACUNGAN**[3]

Accepted: 17 April 2021

Abstract

Introduction Most screening tools identifying women with substance use are not validated, used once in pregnancy, and are not reflective of continued substance use. We hypothesized that serial early prenatal substance screening leads to decreased substance use by the end of pregnancy and improved outcomes.

Methods This is a retrospective cohort study of mothers and their infants between 1/2015 and 12/2017. A self-reported substance screening tool was administered on the first prenatal visit and subsequent visits until delivery. For analysis, mothers were divided into three groups based on the trimester of their first screen and adjusted for demographics and risk factors.

Results Early first trimester screening resulted in 52% of mothers having ≥ 3 screens throughout pregnancy vs. 6% of mothers with late third trimester screens ($p < 0.001$). Compared to third trimester screening, there was a five-fold decrease of any substance use at second trimester, a seven-fold decrease at first trimester, and a nine-fold decrease for marijuana at first trimester. Compared to third trimester screening, there was a significant five-fold increase of negative maternal urine drug screen, 3 ½ -fold increase in well newborn diagnosis, and a five-fold increase of no infant morphine treatment at first trimester.

Discussion We identified improved maternal and infant outcomes with serial early prenatal substance use screening. Early maternal substance use identification is crucial for immediate referral for prevention and treatment, and for social and community services. Further research is needed on universal serial early prenatal screenings.

Keywords Infant outcomes · Maternal outcomes · Prenatal screening · Substance use

Significance

Screening tools for substance use are mostly used once in pregnancy and miss assessments of substance use throughout pregnancy. This is the first study to show that prenatal screening starting in the first trimester and performed periodically throughout pregnancy resulted in decreased substance use by the end of the pregnancy and improved maternal and infant outcomes

Introduction

Opioid use disorder (OUD) among women of reproductive age is a national epidemic (Kennedy-Hendricks et al., 2016), leading to adverse health outcomes in pregnancy, including increased risk of maternal and fetal mortality, obstetric complications, co-occurring mental health disorders, and comorbid medical conditions ((WHO), 2017; Benningfield et al., 2012; Costello & Thompson, 2015; Jones et al., 2008; Lisonkova et al., 2019; McCarthy et al., 2017; Mittal, 2014). In turn, adverse health outcomes increase the risk of relapse and worsening OUD (Clark et al., 2015; Marchuk, 2014).

In the most recent national study, the incidence of illicit drug use among pregnant women age 15–44 years old is 30%, SAMHSA (2017) increasing more than four-fold over the past decade (Haight et al., 2018). As OUD rates

✉ Stacy L. BODEN
stacy.boden@froedtert.com

[1] Department of Pediatrics, West Bend Health Center, Froedtert Health & the Medical College of Wisconsin, 1700 W Paradise Drive, West Bend, WI 53095, USA

[2] Division of Maternal Fetal Medicine, Department of Obstetrics, Gynecology and Women's Health, University of Minnesota Medical School, 420 Delaware St SE, Minneapolis, MN 55455, USA

[3] Division of Neonatology, Department of Pediatrics, Froedtert Health & the Medical College of Wisconsin, 8701 W Watertown Plank Rd, Wauwatosa, WI 53226, USA

Published online: 27 April 2021

in pregnancy have increased, so have rates of neonatal opioid withdrawal syndrome (NOWS) (Patrick et al., 2019). Given the rapidly rising cases of OUD, the Centers for Disease Control and Prevention (CDC), and the World Health Organization (WHO) have named the opioid epidemic a research priority ((ANA), 2016; (WHO), 2017; (ODPHP), 2014; (ACOG), 2012).

In 2012, the American College of Obstetrics and Gynecology ((ACOG), 2012) and CDC recommended substance use screening for all pregnant women regardless of social status, educational level, race, or ethnicity (ACOG, 2017; Wright et al., 2016). Screening, brief intervention, and referral to treatment (SBIRT) is an evidence-based approach to identify and initiate OUD management in pregnancy (Babor et al., 2007). Examples of validated screening tools to identify substance use include the NIDA Quick Screen-ASSIST (Modified Alcohol, Smoking, and Substance Involvement Screening Test), ((NIDA), 2017), the 4P's Plus, (Chasnoff et al., 2007) and the Substance Use Risk Profile-Pregnancy (SURP-P) scale (Yonkers et al., 2010).

A single screening during pregnancy is inadequate to assess the variability of substance use throughout pregnancy. A validated screening tool used instead at regular intervals throughout pregnancy may be more sensitive. Interval screening throughout pregnancy can provide the opportunity for education, assistance, and referral to treatment services early in pregnancy and throughout pregnancy to improve maternal and infant outcomes and potentially to reduce the burden of maternal substance use (ACOG, 2015; Coleman-Cowger et al., 2019; Gopman, 2014; Wong et al., 2011; Wright et al., 2016).

To address the inadequacy of screening only once per pregnancy, we developed a standardized substance use prenatal screening tool given once during each trimester and upon any hospitalization during pregnancy. The study's primary aim was to determine if serial, early self-reported prenatal substance screening leads to decreased substance use by the end of the pregnancy and to improved perinatal outcomes. Our long-term clinical goal is to provide evidence that early administration of a serial standardized prenatal substance screening tool is necessary to identify both illicit and prescribed substance use throughout pregnancy. This tool should ideally be easily adopted into diverse clinical practice models.

Materials and Methods

We conducted a retrospective cohort study of women and their infants using the prenatal clinic and hospital data from an academically affiliated community hospital from January 2015 to December 2017. This study was approved by the Medical College of Wisconsin's Institutional Review Board with a waiver of informed consent.

A substance use screening tool (Boden screening tool, Electronic Supplementary material A) was developed through our clinical program by self-reporting substance use, prescribed and nonprescribed. It was administered at the first prenatal visit and subsequent visits once per trimester until delivery. Using various questions within other research-based alcohol and drug use screening questionnaires, including the modified CAGE and TWEAK questions (Morse et al., 1997), the Boden screening tool was created to identify both prescribed and illicit substances used by pregnant women: marijuana, morphine, methadone, meperidine, oxycodone, propoxyphene, hydromorphone, fentanyl, diazepam, cocaine, heroin, codeine, phenobarbital, clomipramine, hydroxyzine, theophylline, lithium, chlorpromazine, clonidine, diphenhydramine, hydrocodone, lysergic acid diethylamide (LSD), and solvents/aerosols (Electronic Supplementary material A). This tool was completed in the clinic waiting area at routine obstetrical prenatal visits and took approximately 5 min to complete.

Obstetric providers used a positive screen to identify candidates for referral to community resources and drug treatment programs. Pregnant women using substances, either prescribed or illicit, were referred to a pediatric provider for education regarding the need for observation and possible NOWS treatment, if indicated, after birth. The data gathered from the screening tool was part of the pregnant woman's electronic medical record.

We used electronic medical records of patient-infant dyads to collect the following: demographics and urine drug screen results; tobacco and alcohol use, family history of substance use, and the number of prenatal substance use screenings. Urine drug screens were voluntarily collected only if self-reported prenatal screening were positive. Infant data included gestational age at delivery, diagnosis of NOWS, pharmacologic treatment of NOWS with morphine, hospital length of stay (LOS), and results of infant urine and meconium drug screenings.

For analysis, women were divided into three groups based on the timing of their first screen: first trimester (0–13 weeks), second trimester (14–26 weeks), and third trimester (27–41 weeks). We performed a McNemar test by doing before and after substance use measurements (matched pairs) to determine if early prenatal screening affected prenatal substance use by the end of pregnancy. We performed Poisson regression to find differences in LOS between the three groups. We also performed bivariate and multivariate logistic regression to examine the relationship between the three groups regarding pregnancy and infant outcomes.

Analyses were conducted using Stata15/SE (Stata Corp, College Station, TX). Categorical variables are presented

as percentages. Logistic and ordinal logistic regression results are presented as Odds Ratios (OR) and 95% confidence intervals with the third trimester (27–41 weeks) as the reference group. Regressions were adjusted for maternal demographics and risk factors.

Results

Two hundred fifty-one women were identified to have substance use on their first prenatal screen based on the positive substance use screening tool (Boden screening tool, Electronic Supplementary material A). Significant differences were noted in demographics and risk factors between the three trimesters (Table 1). Older maternal age ($p < 0.05$), nulliparity ($p < 0.05$), marital status ($p < 0.001$), higher income ($p < 0.05$), private insurance ($p < 0.01$), and current employment ($p < 0.05$) were associated with early prenatal screening. Alcohol use was associated with early prenatal screening, but not tobacco use. In the first trimester, screening resulted in 52% of pregnancies having ≥ 3 screens before birth compared to 6% of women with ≥ 3 screens in their third trimester ($p < 0.001$). Positive screening in the second and third trimesters resulted in 56–60% of obtaining

Table 1 Significant maternal demographics and risk factors between the three groups of the earliest prenatal substance screen[a]

Maternal demographics	Earliest prenatal substance screen (%)		
	1st trimester (N = 174)	2nd trimester (N = 41)	3rd trimester (N = 35)
1. Maternal age*			
< 20 years old	6.3	4.9	5.7
20–29 years old	56.3	78.1	74.3
30–39 years old	37.4	14.6	20.0
> 39 years old	0.0	2.4	0.0
2. Race			
Caucasian/white	93.7	92.9	85.7
African American/Black	2.9	4.8	5.7
Hispanic	3.4	2.4	2.9
Other	0.0	0.0	5.7
3. Nulliparity*	37.0	19.0	17.1
4. Marital Status (Married)***	48.3	11.9	28.6
5. ZipCode median income quartile*			
1st quartile ($1–42,999)	0.6	9.8	5.7
2nd quartile ($43,000–53,999)	8.0	0.0	5.7
3rd quartile ($54,000–70,999)	71.8	68.3	77.1
4th quartile ($71,000 +)	19.5	21.9	11.4
6. Private insurance**	40.8	11.9	22.9
7. Employed*	69.4	54.8	45.7
Maternal risk factors			
1. Tobacco use*	39.7	61.9	54.3
2. Alcohol use*	28.9	9.5	17.6
3. Any family member with drug use	22.2	21.4	25.7
4. No. of prenatal screening before birth***			
0–1	20.8	34.2	61.3
2	27.0	44.7	32.3
≥ 3	52.2	21.0	6.4
5. Urine drug screen done***			
No	73.7	43.9	40.0
Yes, once	20.5	41.5	42.9
Yes, > 1	5.8	14.6	17.1

[a]Chi-Square or Fisher Exact test

*p value < 0.05

**p value < 0.01

***p value < 0.001

urine drug screens compared to a 26% rate when positively screened in the first trimester.

For women with early prenatal screening in their first trimester, there was a decrease of any self-reported substance use by 72%, marijuana by 57%, all opiates by 40%, and benzodiazepine use by 76% when rescreened at the end of their pregnancy (Fig. 1). For those with initial screening in their second trimester**,** there was a smaller decrease in any self-reported substance use by 44%, marijuana by 36%, all opiates by 20%, and benzodiazepine use by 50% when rescreened at the end of their pregnancy. We even found a much smaller decrease when screened in their third trimester in any substance by 6%, marijuana by 9%, all opiates by 0%, and benzodiazepine use by 15% when rescreened at the end of their pregnancy. Please see Electronic Supplementary material B for the list of other substances analyzed.

At the end of pregnancy, 15% of women who were initially screened in the first trimester had a positive urine drug screen compared to 44–45% of women screened in their second and third trimesters (Fig. 2). Also, infants of women screened in the first trimester had an 8% positive infant urine drug screen and a 10% positive meconium drug screen. We found a much higher positive urine and meconium drug screen result when women were initially screened later in pregnancy (Fig. 3). Please see Electronic Supplementary material C for the substances found in the combined maternal and infant urine drug screens and infant meconium drug screen.

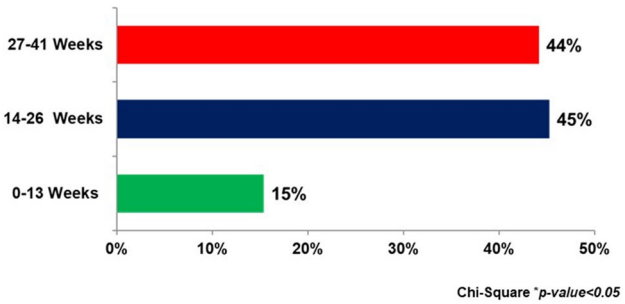

Fig. 2 Decreased positive maternal urine drug screens at end of pregnancy*

Table 2 shows differences in infant outcomes. We noted lower rates of positive opioid urine and meconium drug screen results, diagnosis of NOWS, and NOWS requiring morphine treatment when pregnancies were screened early in the first trimester, compared to later screenings in the second and third trimesters. The mean infant hospital LOS with initial screening in the second trimester was twice as long as with early screening in the first trimester. Using Poisson regression, we identified a significant increase in LOS in those with initial second-trimester screening, but not for initial third-trimester screening, using the first trimester as reference.

Table 3 shows the adjusted OR of outcomes when analyzed by the trimester, where the earliest prenatal substance

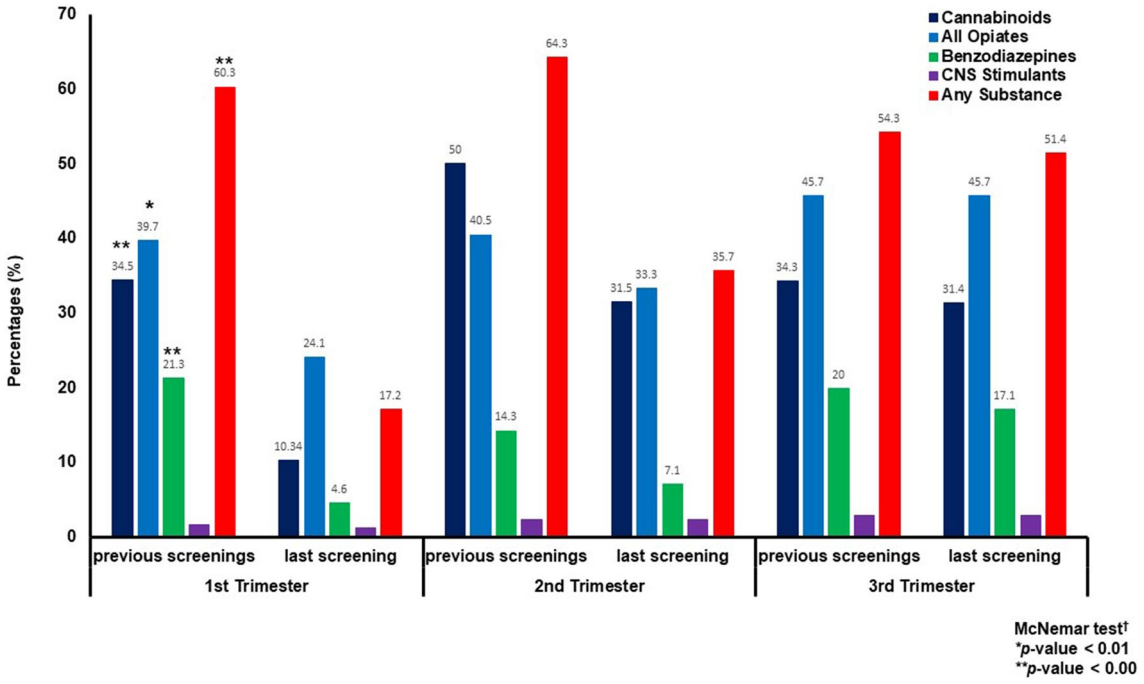

Fig. 1 Significant decrease of any substance, marijuana and opiate use between previous vs. end of pregnancy screenings†

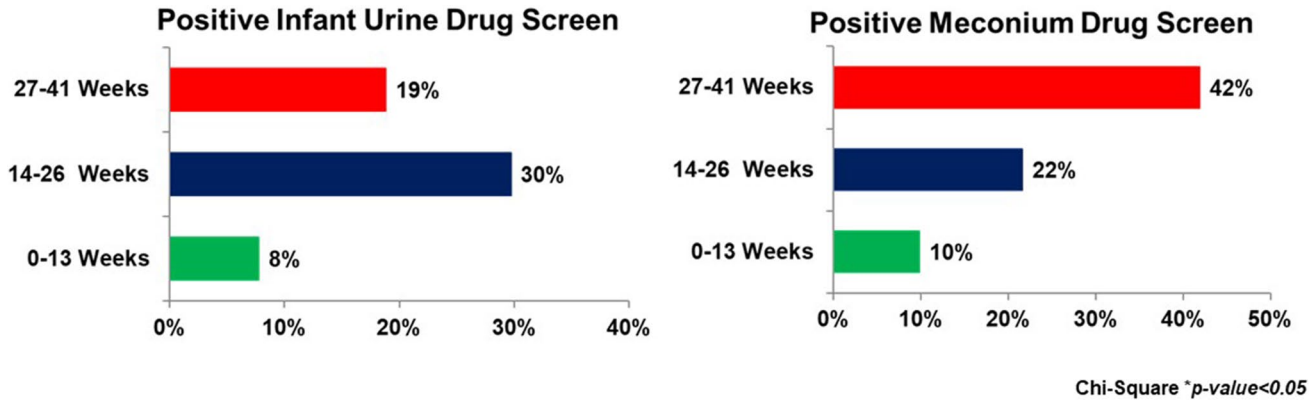

Fig. 3 Decreased positive infant urine and meconium drug screens with first trimester screening*

Table 2 Significant differences in infant outcomes between the three groups of the earliest prenatal substance screen[b]

Infant outcomes[b]	Earliest prenatal substance screen (%)		
	0–13 weeks (N = 174)	14–26 weeks (N = 41)	27–41 weeks (N = 35)
1. Gestational age (Term)	85.7	78.9	96.9
2. Opiates in urine and meconium[a]	8.1	19.1	17.1
3. Diagnosis*			
Well newborn	91.5	69.4	71
NOWS	8.5	30.6	29
4. Treatment with morphine*	5.9	30.6	25.8
5. Length of stay (days)[c]			
Mean ± SD	4.4 ± 7.6	7.7 ± 8.4[d]	6.3 ± 6.7
Median (25th-75th%ile)	2 (2–3)	3 (2–14)	3 (2–7)

[a]combined maternal and infant urine drug screen, and infant meconium drug screen

[b]Fisher Exact test or Chi-Square test

[c]Poisson regression

[d]compared to 0–13 weeks, $p < 0.05$ for 14–26 weeks, *NS* for 27–41 weeks

*p value < 0.001

screening was administered. There was a five-fold decrease of any substance use with the initial screen in the second trimester for maternal outcomes, and a seven-fold decrease with the initial screen in the first trimester. Compared to initial screening in the third trimester, there was also a nine-fold decrease in marijuana use with screening in the first trimester but no significant reduction with screening in the second trimester. We found no significant differences in decreased opioid use and benzodiazepine use between the three trimesters. We also found a significant five-fold increase in a negative maternal urine drug screen when self-reported screening was first done in the first trimester compared to in the third trimester. For infant outcomes, we found more than a three-fold increase of no newborn diagnosis of NOWS, and a five-fold increase of no infant morphine treatment for NOWS (when identified) when patients were screened early in the first trimester compared to initial screening in the third trimester.

Discussion

In a cohort of women at an academic-affiliated community hospital, this study demonstrates that prenatal screening starting in the first trimester and performed periodically throughout pregnancy resulted in decreased reported substance use by the end of the pregnancy and improved outcomes. This approach to periodic screening during pregnancy has several advantages. Periodic screening provides additional information to the health care team about the timing of substance use and indications of ongoing use. Given the legal and social barriers which often discourage pregnant women from reporting substance use to their healthcare providers, periodic screening may further identify ongoing substance use. In this study, early self-reported serial prenatal screening throughout pregnancy was associated with earlier identification of substance use and prompt referral for counseling and community services. We speculate that this may contribute to the study's improved outcomes.

Substance use and substance use disorders continue to be frequently missed diagnoses in pregnancy. In order to decrease substance use and increase substance use disorder detection, a more patient-centered approach to screening in pregnancy may be required (Price et al., 2018). Current recommendations advise early universal screening in pregnancy by using a screening tool at the first prenatal visit. Those with a substance use disorder in pregnancy can be identified

Table 3 Significant Adjusted Odds Ratio [OR (95%CI)] for maternal and infant outcomes between the three groups of the earliest prenatal substance screen[a]

Outcomes	Earliest prenatal substance screen		
	27–41 weeks	14–26 weeks	0–13 weeks
		aOR (95%CI)	aOR (95%CI)
Maternal outcomes			
1. Decrease in any substance use	Ref	4.81 (1.91–19.43)*	6.64 (1.8–23.91)**
2. Decrease in marijuana use	Ref	7.72 (0.84–70.84)	9.12 (1.06–78.29)*
3. Decrease in opiate use	Ref	2.71 (0.45–16.50)	2.98 (0.58–15.23)
4. Decrease in benzodiazepines use	Ref	1.65 (0.13–20.83)	3.13 (0.35–28.17)
5. Having a negative maternal urine drug screen result	Ref	1.16 (0.19–7.08)	5.19 (1.05–25.73)*
Infant outcomes			
1. Having a well newborn, instead of NOWS	Ref	1.07 (0.32–3.58)	3.53 (1.11–11.28)**
2. Not on medications for NOWS	Ref	0.94 (0.27–3.32)	4.69 (1.32–16.65)*

[a]Logistic regression

*p value < 0.05

**p value < 0.01

and referred for treatment to improve pregnancy outcomes ((ACOG), 2017).

When examining individual screening tools, the 4P's Plus is the only validated tool for assessing drug and alcohol use in pregnancy. The SURP-P screen asks about marijuana and alcohol use only but is not validated in pregnancy. Both 4P's Plus and SURP-P have high sensitivity as screening tests but do not assess behavioral substance use patterns, cravings, or substance use consequences. The NIDA Quick Screen-ASSIST assesses cravings and functional consequences as well as behavioral substance use patterns. However, this screen has a lower sensitivity of 85.4%, making it a lesser desirable screening test compared to the 4P's Plus and the SURP-P (Coleman-Cowger et al., 2019).

Compared to the 4P's Plus, SURP-P, and the NIDA Quick Screen-ASSIST, the Boden screening tool asks what prescribed and illicit substances were used in the past 3 months. Like the NIDA Quick Screen-ASSIST, we modified the CAGE and TWEAK alcohol screening questionnaires for adults to better assess craving and behavioral substance use patterns (Armstrong et al., 2001; Morse et al., 1997).

The Boden tool is an example of a patient-centered care approach. The tool allows for informed consent before screening, thus fulfilling the ethical principle of respect for persons, and fulfills the ethical principle of autonomy by allowing patients to make an informed decision about their care. Compared to universal urine drug screening, where the identification of drug use may be a stressor, this patient-centered approach allows for more collaboration with the health care team, improving the identification and treatment of substance use during pregnancy. One study on the patient-centered care approach identified decreased substance use leading to improved pregnancy and infant outcomes (Wright et al., 2012).

Using our tool early and throughout pregnancy, we were able to identify pregnant women at high risk for substance use. This led to a revision of our clinic workflow based on Kaiser Permanente's Early Start program (Armstrong et al., 2001). Our workflow used various strategies, including the Boden screening tool, urine drug screening, early intervention, ongoing counseling, and case management by a licensed clinical social worker and pediatric nurse practitioner with expertise in substance abuse (Armstrong et al., 2003). This change in workflow helped the clinic and hospital improve provider and staff awareness of increasing substance use. The workflow change also allowed for earlier identification of substance use, allowing more time for education on the adverse effects of substance use in pregnancy. This expanded the ability to recommend treatment programs when needed, provide women with information on various community resources, and increase collaborative efforts with community programs.

We realize that pregnant women with substance use and substance use disorders face significant obstacles and barriers when seeking prenatal care. Research shows pregnant women fear they may lose custody of their children, as more than 50% of children of women with OUD are not living with their biological parents by the time they are 5 years of age (Burns et al., 2006). They may also face significant stigma from their families, social networks, and healthcare system (Jones et al., 2008). Unfortunately, the use of substances in pregnancy has been identified in some state statutes as evidence of child abuse or neglect. Many patients have been prosecuted, which can be a barrier to care and

may play a role in suboptimal outcomes (McCarthy et al., 2017). In particular, rural areas create challenges for accessing community services and substance use disorder treatment (Jackson & Shannon, 2012). Such obstacles may result in adverse health outcomes and increase morbidity and mortality in this population.

Of note, the implementation of the Boden screening tool has had other notable benefits to perinatal care. Expanded education of providers and staff has improved awareness of substance use disorders in pregnancy. As more pregnancies are identified with the risk of substance use disorder complications, this tool has prompted the implementation of a county-wide task force, which has enhanced awareness of substance use disorders in pregnancy and has led to further collaboration within the public health community.

This study identified an overall increased incidence of marijuana use in pregnancy, which has been supported in other studies (Brown et al., 2017). Marijuana is the most common illicit drug identified in pregnancy, followed by amphetamine-type stimulants and opioids (Forray, 2016). Surprisingly in our study, we found a significant decrease in marijuana and opioid use for women screened early in pregnancy but did not find a similar decrease for amphetamine use.

This study identified higher positive urine and meconium drug screen rates in infants when pregnancies were screened in their second and third trimesters. This is consistent with the meconium drug screen detection window for substance use, usually identified as the second and third trimesters of pregnancy (Lozano et al., 2007). Besides, the meconium drug screen provides more complete information on drug exposure during pregnancy compared to the infant urine drug screen.

Weaknesses of the study include the use of self-reporting of substance use. However, we had a very high response rate for a positive self-report, compared to one study that showed only 5% of women admit to using illicit drugs while pregnant ((CBHSQ), 2015). There could also be recall bias when filling out the prenatal screening tool. Besides, we could not confirm the patient report of substance use definitively as urine drug screens were not collected after every screening, and urine drug screens also have significant limitations in confirming substance use. The Boden screening tool has not yet been validated in a more diverse population, and this is a retrospective study from a single obstetric community practice. Despite these limitations, we were able to show improved maternal and infant outcomes with the early administration of a serial standardized prenatal substance screening tool.

In conclusion, using the Boden screening tool throughout pregnancy is associated with decreased reported substance use during pregnancy and improved perinatal outcomes. Further research is needed on newer approaches to substance use screening, such as the patient-centered care approach, and comparing this tool to other validated pregnancy screening tools.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s10995-021-03127-1.

Declarations

Conflict of interest The authors have no financial relationship to declare and no conflict of interest.

References

American College of Obstetrics and Gynecology (ACOG). (2012). Committee opinion no. 524: Opioid abuse, dependence, and addiction in pregnancy. *Obstetrics and Gynecology, 119*(5), 1070–1076

American College of Obstetrics and Gynecology (ACOG). (2015). Committee opinion no. 633: Alcohol abuse and other substance use disorders: Ethical issues in obstetric and gynecologic practice. *Obstetrics and Gynecology, 125*(6), 1529–1537

American College of Obstetrics and Gynecology (ACOG). (2017). Committee opinion no. 711: Opioid use and opioid use Disorder in Pregnancy. *Obstetrics and Gynecology, 130*(2), e81–e94

American Nurses Association (ANA). (2016). *Nursing's role in addressing Nation's opioid crisis*. Silver spring, MD. Retrieved from https://www.nursingworld.org/~4ae212/globalassets/docs/ana/ana_nursings-role-in-opioid-crisis_2016.pdf

Armstrong, M. A., Gonzales Osejo, V., Lieberman, L., Carpenter, D. M., Pantoja, P. M., & Escobar, G. J. (2003). Perinatal substance abuse intervention in obstetric clinics decreases adverse neonatal outcomes. *Journal of Perinatology, 23*(1), 3–9

Armstrong, M. A., Lieberman, L., Carpenter, D. M., Gonzales, V. M., Usatin, M. S., Newman, L., & Escobar, G. J. (2001). Early start: An obstetric clinic-based, perinatal substance abuse intervention program. *Quality Management in Health Care, 9*(2), 6–15

Babor, T. F., McRee, B. G., Kassebaum, P. A., Grimaldi, P. L., Ahmed, K., & Bray, J. (2007). Screening, brief intervention, and referral to treatment (SBIRT): Toward a public health approach to the management of substance abuse. *Substance Abuse, 28*(3), 7–30

Benningfield, M. M., Dietrich, M. S., Jones, H. E., Kaltenbach, K., Heil, S. H., Stine, S. M., Coyle, M. G., Arria, A. M., O'Grady, K. E., Fischer, G., & Martin, P. R. (2012). Opioid dependence during pregnancy: Relationships of anxiety and depression symptoms to treatment outcomes. *Addiction, 107*(Suppl 1), 74–82

Brown, Q. L., Sarvet, A. L., Shmulewitz, D., Martins, S. S., Wall, M. M., & Hasin, D. S. (2017). Trends in marijuana use among pregnant and nonpregnant reproductive-aged women, 2002–2014. *JAMA, 317*(2), 207–209

Burns, L., Mattick, R. P., & Cooke, M. (2006). The use of record linkage to examine illicit drug use in pregnancy. *Addiction, 101*(6), 873–882

Center of Behavioral Health Statistics and Quality (CBHSQ). (2015). 2014 National survey on drug use and health: Detailed tables. Rockville, MD: Substance abuse and mental health services administration. https://www.samhsa.gov/data/sites/default/files/NSDUH-DetTabs2014/NSDUH-DetTabs2014.pdf. Accessed 18 September 2019

Chasnoff, I. J., Wells, A. M., McGourty, R. F., & Bailey, L. K. (2007). Validation of the 4P's Plus screen for substance use in pregnancy

validation of the 4P's Plus. *Journal of Perinatology, 27*(12), 744–748

Clark, R. E., Baxter, J. D., Aweh, G., O'Connell, E., Fisher, W. H., & Barton, B. A. (2015). Risk factors for relapse and higher costs among medicaid members with opioid dependence or abuse: Opioid agonists, comorbidities, and treatment history. *Journal of Substance Abuse Treatment, 57*, 75–80

Coleman-Cowger, V. H., Oga, E. A., Peters, E. N., Trocin, K. E., Koszowski, B., & Mark, K. (2019). Accuracy of three screening tools for prenatal substance use. *Obstetrics and Gynecology, 133*(5), 952–961

Costello, M., & Thompson, S. (2015). Preventing opioid misuse and potential abuse: The nurse's role in patient education. *Pain Management Nursing, 16*(4), 515–519

Forray, A. (2016). Substance use during pregnancy. *F1000Research, 5*(887), 1–9

Gopman, S. (2014). Prenatal and postpartum care of women with substance use disorders. *Obstetrics and Gynecology Clinics of North America, 41*(2), 213–228

Haight, S. C., Ko, J. Y., Tong, V. T., Bohm, M. K., & Callaghan, W. M. (2018). Opioid use disorder documented at delivery hospitalization - United States, 1999–2014. *MMWR: Morbidity and Mortality Weekly Report, 67*(31), 845–849

Jackson, A., & Shannon, L. (2012). Barriers to receiving substance abuse treatment among rural pregnant women in Kentucky. *Maternal Child Health Journal, 16*(9), 1762–1770

Jones, H. E., Martin, P. R., Heil, S. H., Kaltenbach, K., Selby, P., Coyle, M. G., Stine, S. M., O'Grady, K. E., Arria, A. M., & Fischer, G. (2008). Treatment of opioid-dependent pregnant women: Clinical and research issues. *Journal of Substance Abuse Treatment, 35*(3), 245–259

Kennedy-Hendricks, A., McGinty, E. E., & Barry, C. L. (2016). Effects of competing narratives on public perceptions of opioid pain reliever addiction during pregnancy. *Journal of Health Politics, Policy and Law, 41*(5), 873–916

Lisonkova, S., Richter, L. L., Ting, J., Muraca, G. M., Wen, Q., Mehrabadi, A., Mitchell-Foster, S., Oviedo-Joekes, E., & Lyons, J. (2019). Neonatal abstinence syndrome and associated neonatal and maternal mortality and morbidity. *Pediatrics, 144*(2), e20183664

Lozano, J., Garcia-Algar, O., Vall, O., de la Torre, R., Scaravelli, G., & Pichini, S. (2007). Biological matrices for the evaluation of in utero exposure to drugs of abuse. *Therapeutic Drug Monitoring, 29*(6), 711–734

Marchuk, A. (2014). A personal nursing philosophy in practice. *Journal of Neonatal Nursing, 20*(6), 266–273

McCarthy, J. J., Leamon, M. H., Finnegan, L. P., & Fassbender, C. (2017). Opioid dependence and pregnancy: Minimizing stress on the fetal brain. *American Journal of Obstetrics and Gynecology, 216*(3), 226–231

Mittal, L. (2014). Buprenorphine for the treatment of opioid dependence in pregnancy. *Journal of Perinatal and Neonatal Nursing, 28*(3), 178–184

Morse, B., Gehshan, S., & Hutchins, E. (1997). *Screening for substance abuse during pregnancy: Improving care, improving health*. Arlington, VA. Retrieved from Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration 2018.

National Institute of Drug Abuse (NIDA). (2017). Resource guide: Screening for drug use in general medial settings. Retrieved from https://www.drugabuse.gov/publications/resource-guide/preface

Patrick, S. W., Faherty, L. J., Dick, A. W., Scott, T. A., Dudley, J., & Stein, B. D. (2019). Association among county-level economic factors, clinician supply, metropolitan or rural location, and neonatal abstinence syndrome. *JAMA, 321*(4), 385–393

Price, H. R., Collier, A. C., & Wright, T. E. (2018). Screening pregnant women and their neonates for illicit drug use: Consideration of the integrated technical, medical, ethical, legal, and social issues. *Frontiers in Pharmacology, 9*, 961

Substance Abuse and Mental Health Services Administration (SAMHSA). (2017). *Results from the 2017 National survey on drug use and health: Detailed tables*. Retrieved from Rockville, Maryland.

US Department of Health and Human Services, Office of Desease Prevention and Health Promotion (ODPHP). (2014). Healthy people: Maternal, infant and child health. Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/maternal-infant-and-child-health/objectives

Wong, S., Ordean, A., Kahan, M., & Society of Obstetricians and Gynecologists of Canada. (2011). SOGC clinical practice guidelines: substance use in pregnancy: No 256, April 2011. *International Journal of Gynaecology and Obstetrics, 114*(2), 190–202

World Health Organization (WHO). (2017). *Evidence evaluation report - substance use*. Retrieved from https://consultations.health.gov.au/health-services-division/antenatal-care-guidelines-review/supporting_documents/Illicit%20substance%20use%20evaluation%20report%2022May17.pdf

Wright, T. E., Schuetter, R., Fombonne, E., Stephenson, J., & Haning, W. F. (2012). Implementation and evaluation of a harm-reduction model for clinical care of substance using pregnant women. *Harm Reduction Journal, 9*(5), 1–10

Wright, T. E., Terplan, M., Ondersma, S. J., Boyce, C., Yonkers, K., Chang, G., & Creanga, A. A. (2016). The role of screening, brief intervention, and referral to treatment in the perinatal period. *American Journal of Obstetrics and Gynecology, 215*(5), 539–547

Yonkers, K. A., Gotman, N., Kershaw, T., Forray, A., Howell, H. B., & Rounsaville, B. J. (2010). Screening for prenatal substance use: Development of the substance use risk profile-pregnancy scale. *Obstetrics and Gynecology, 116*(4), 827–833