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Syndemics of Sexually Transmitted Infections in a Sample of Racially Diverse Pregnant Young Women

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Abstract

Introduction Syndemic theory posits that poor health outcomes co-occur and amplify each other in the context of harmful conditions that must be addressed simultaneously to improve health equity. This analysis identifies perinatal syndemic factors and examine how factors are related to STI in a sample of racially diverse young pregnant women.

Methods Pregnant participants (n = 61) ages 14–21 from racially diverse backgrounds were recruited from a prenatal clinic for an ongoing longitudinal study between October 2019-February 2020. Participants completed a tablet survey assessing pregnancy intention, psychosocial factors (e.g., depression, stress, partner violence, pregnancy history) and consented to provide access to their medical records for STI and clinical urine samples screened for tobacco and cannabis use. Latent class analysis (LCA) was used to examine probabilities of co-occurring Syndemic indicators.

Results Half of the women were Black (52%) and primigravida (54%). Three classes were identified in the LCA, two of them reflecting syndemics related to STI from the medical record. The largest class was half Black (51%), with a high rate of STI (65%), and was characterized by factors including depressive symptoms (93%), stress (64%), and substance use (65% cannabis, 82% tobacco). Additionally, the class with the highest rates of STI (74%) also had higher rates of partner violence (48%), morning sickness (100%), and prenatal cannabis use (63%).

Conclusion Findings indicate evidence of a syndemic related to increased STI. A longitudinal evaluation of syndemics in this cohort may inform appropriately tailored intervention strategies to promote perinatal health in racially diverse young pregnant populations.

Keywords Syndemics · Perinatal Health · Sexually Transmitted Infections · Adolescent and Young Adult

Significance

Black and other minority women are disproportionately impacted by sexually transmitted infections (STI) compared to their white counterparts in the United States. Perinatal STIs are associated with poor pregnancy outcomes and the risks for acquisition are influenced by syndemics, including mental health, substance use and experiences of violence, that capture the disproportionate morbidity in perinatal populations. In our study we found that STIs were high in the sample and evidence of syndemics were determined and highlight heterogeneity among younger Black pregnant participants from this sample who were had the lowest rates of STI and prenatal substance use.

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Introduction

Black, Indigenous and Hispanic/Latina women are disproportionately impacted by sexually transmitted infections (STI) compared to their white counterparts in the United States (Bowen et al., 2019). Young minority women aged 15–24 are at particularly high risk, as young adults make up half of all new STIs in the US each year (Bowen et al., 2019). Sexually active minoritized young women are much

more likely to become pregnant and give birth at a younger age, which in turn, may increase their risk of perinatal STI and associated adverse pregnancy and birth outcomes (Mathews & Hamilton, 2016). During pregnancy, STIs are known to increase the risk of preterm birth, preeclampsia and pregnancy loss (Bagheri et al., 2018; Haggerty et al., 2013; Ashley V Hill et al., 2020). Multiple factors may influence the higher prevalence of STIs among adolescents and young adults, including mental health challenges (Brown et al., 2010), substance and alcohol use (Green et al., 2017; Khan et al., 2012) and the influence of cultural or social factors (Harris et al., 2017). These disparities in infection and adverse outcomes have often incorrectly been attributed to individual level behavioral factors (Burris et al., 2019), leading to increased stigma and ineffective behavioral interventions. However, disparities in reproductive health are increasingly understood to be caused by societal norms that place Black and Brown communities at the intersection of pervasive systems that marginalize and disenfranchise them from achieving optimal health (Hogan et al., 2001).

Younger pregnant women and women who are racial minorities have a higher likelihood of substance use, such as cannabis, than their non-pregnant counterparts (Salas-Wright et al., 2015; Young-Wolff et al., 2019). For example, in a study from a large health care system with universal screening for prenatal cannabis use, Black women were three times more likely to report weekly cannabis use and four times more likely to report daily cannabis compared to Hispanic and white women (13). While women often report cannabis use during pregnancy to alleviate pregnancy related symptoms such as nausea and vomiting (Young-Wolff et al., 2018), most women initiate cannabis use well before pregnancy, by ages 16–18 (Alcover & Thompson, 2020; Chen et al., 2017). Additionally. recent literature suggests that experiences with stressors related to structural factors are associated with increased cannabis use among adolescent minorities (Walsh et al., 2018). Previous studies have connected cannabis use to a constellation of health issues, including increased risk of sexually transmitted infection, mental health problems and pregnancy at a younger age (Chapman & Wu, 2013; De Genna et al., 2007), although more recent literature is needed. Cannabis use is increasingly understood to be unsafe for the pregnancy and growing fetus (Haight et al., 2021; Volkow et al., 2017). Both cannabis use and exposure to discrimination in adolescence appear to be correlated with elevated levels of stress hormones (Barton et al., 2018), which in turn may contribute to inflammation and poor cardiovascular health, including poor pregnancy outcomes (Brody et al., 2015).

Syndemic theory suggests that social conditions that increase stress significantly influence disease course and progression which co-occur and interact to increase risk for adverse health outcomes (Singer et al., 2017). Particularly in pregnancy, factors such as stress, depression, alcohol, smoking, and drug use may amplify each other, increasing risk for adverse pregnancy and infant outcomes (De Genna et al., 2015, 2017; Richardson et al., 2019). Syndemic theory – the co-occurrence and interaction of multiple health epidemics – acknowledges health risk behaviors may be influenced by psychological stressors and other social conditions (e.g., experiences with violence, gendered racism) (McDonald et al., 2017). By highlighting the interactions of a range of health concerns, a syndemic approach offers an opportunity to identify key externally modifiable targets to develop approaches that are tailored for specific subgroups. Further, unique syndemic profiles of STI risk have been demonstrated in non-pregnant young minority women (A. V. Hill et al., 2019). Elucidating how syndemic conditions influence STI during pregnancy in younger populations will begin to address substantial gaps in reproductive health disparities research and identify specific targets for intervention among young women (National Academies of Sciences Engineering & Medicine, 2021). This includes approaches that examine and prioritize the intersectional identities and specific socio-political drivers of STI in high burden populations (National Academies of Sciences Engineering & Medicine, 2021). Syndemic approaches have long been applied to HIV studies in high risk men who have sex with men (MSM) and have recently been recommended as a guiding strategy to improve maternal health for Black perinatal populations during the COVID-19 pandemic (Lemke & Brown, 2020).

While the utility of syndemic approaches are apparent, studies of syndemics in perinatal populations are scarce (Laurenzi et al., 2020). Martinez and colleagues examined traditional syndemic indicators among pregnant Latina couples finding a syndemic comprised of substance use, partner violence and perinatal depression (Martinez, Ickovics, et al., 2018; Martinez, Kershaw, et al., 2018). Authors determined that syndemic severity, calculated by summing the syndemic indicators, persisted and increased across pregnancy for the female partner. In a separate analysis, acculturation was examined as a moderator of syndemic severity among pregnant adolescent Latinas followed from pregnancy to one year postpartum (Martinez, Ickovics, et al., 2018; Martinez, Kershaw, et al., 2018). Immigrant participants were less likely to display a syndemic of substance use, partner violence and depression. However, first and second generation participants were much more likely to engage in substance use, report partner violence, and depression which increased in severity over time. Thus, syndemics are evident in Latina adolescent pregnancies and present opportunities for modifiable factors that may improve pregnancy and birth outcomes for young Latina women at high risk for adverse outcomes. However, to date there have been no studies of syndemics in young Black women, even though Black women are also at-risk of perinatal STI and associated adverse birth outcomes.

In Pennsylvania, approximately 14% of all low birth weight infants and 13% of preterm births are among Black women compared to white women (Pennsylvania Department of Health, 2017). Roughly 40% of Black, Multi-racial and Hispanic women across the state received no prenatal care during their first trimester or received less than optimal care compared to white women (low birth weight: 8.4%; preterm birth: 8.7%) (Pennsylvania Department of Health, 2017, 2020). Only 23% of women who had a live birth in 2015 discussed health behaviors and preconception care with a medical practitioner before becoming pregnant (Pennsylvania Department of Health, 2020). These statistics suggest that in addition to improving preconception and perinatal health for young women broadly, particular attention is needed in this geographic region, particularly for Black women. Along with commonly recognized syndemic factors such as partner violence, depression, and substance use, it is also important to consider pregnancy-specific factors such as pregnancy intention, parity and pregnancy related symptoms, such as nausea and vomiting. Therefore, the objective of this study was to identify syndemic profiles of co-occurring risk factors for STIs among pregnant young women participating in an ongoing longitudinal study examining trajectories of cannabis and tobacco use in Western Pennsylvania.

Methods

Data were from the ongoing YoungMoms Study (R01 DA046401) which examines current patterns and levels of prenatal cannabis use and co-use with tobacco in adolescent and young adult women seeking prenatal care. The YoungMoms Study uses a mixed-method, multiple reporter (anonymous tablet surveys, interviews, medical records, biological testing) approach to collect quantitative and qualitative data to assess prenatal cannabis exposure (PCE) and co-use with tobacco in pregnant adolescents and young adults. Young pregnant women presenting for prenatal care at a major maternity hospital in Pittsburgh, PA that serves Southwestern Pennsylvania were approached by study personnel to describe the study and consent young women to participate from October 2019-February 2020. All study procedures were approved by the University of Pittsburgh Institutional Review Board.

Inclusion criteria for the YoungMoms Study include 21 years of age or younger, confirmed pregnancy, prenatal care at the maternal hospital or affiliated clinic, read and speak English well enough to provide informed consent and complete English survey materials, and residence close enough to return to the university offices for postpartum visits. Of the 104 women that were approached by clinic staff about the study prior to March 2020, five were not interested in learning more about the study, 24 refused to participate after speaking with research staff members, and 75 were enrolled in the study. Data were collected from multiple sources, including biological specimens (e.g., urine), electronic medical records and self-report surveys to assess cannabis and tobacco use before and during pregnancy and to evaluate the effects of perinatal exposures on pregnancy outcomes and infant development.

Measures

Demographic information, parity, gravidity, pregnancy intentions and planning were collected through self-report tablet surveys completed at the prenatal clinic. Demographic characteristics assessed in the tablet surveys included maternal age, race/ethnicity, if they were currently in school or working and living situation (e.g., alone, with parents, with a romantic partner, with a friend(s)).

Urine samples provided by participants for clinical care were screened for cotinine and THC using point-of-care immunoassay testing within one hour of collection (n = 61). Reasons for missing urine samples included: no urine specimen provided by the patient for this appointment, not enough specimen to collect after clinical tests were conducted, urine specimen disposed of by clinical staff before research team member arrived for collection. The urine dip tests are FDA-approved, use Substance Abuse and Mental Health Services Administration (SAMHSA) cut-off levels, and have a 97% accuracy rate (Rapid Detect Inc., 2016). Presence of cannabis and tobacco metabolites ascertained using the rapid dip tests were included as binary response variables (yes/no). Participants were also asked "After you found out you were pregnant how often did you drink alcoholic drinks?" to assess alcohol use. Participants could list any numeric response that were dichotomized into 0 for never or 1 or more as ever perinatal use.

Maternal exposure to physical or sexual violence was measured using 3 items from the Conflict Tactics Scale-2 (Straus et al., 1996) and the Sexual Experiences Survey (Koss & Gidycz, 1985) modified for younger women. Participants were asked if "someone you were going out with or hooking up with EVER hit, pushed, slapped, choked, or otherwise physically hurt you? (include such things as being hit, slammed into something, or hurt you with an object or weapon); if "someone you were going out with or hooking up with EVER used force or threats to make you have sex (vaginal, oral, or anal sex) when you didn't want to?; or if "you EVER had sex with someone you were going out with or hooking up with when you didn't want to because you felt like you didn't have a choice, even though they did not use physical force or threats?" A binary composite variable to describe ever experiencing relationship violence was created

with a score of "1" if young women responded "yes" to any of the above questions.

Perceived stress was measured using the 4-item version of the Perceived Stress Scale (Warttig et al., 2013), a well validated measure that is appropriate for use in adolescents (Martin et al., 1995). Two items are positively worded and two items are negatively worded; positively worded items were reverse coded and scores were summed (range: 0–16) with higher scores indicating more stress. There is no suggested cut point for the PSS-4, however a recent study included a cut point of scores of 6 or higher to indicate high stress (Scheidell et al., 2020). In this sample, responses were dichotomized to indicate a score of 8 (top quartile) or more as higher levels of stress.

Depressive symptoms were measured using the 8-item PROMIS scale for emotional distress (Pilkonis et al., 2011). Response options may range from 7–35, with a score of 16 or higher indicating higher risk of depression. Participants scores were summed and dichotomized to indicate depression (≥ 16) or not depressed (< 16).

History of Sexually Transmitted Infections (STI) was assessed through medical record review. A binary STI variable (0 = no, 1 = yes) was created for a positive clinical test for any of the following common STIs: Chlamydia, gonorrhea, trichomonas, herpes simplex virus-2, and genital warts.

Statistical Analysis

Descriptive statistics were computed for variables representing characteristics of participants in the sample. Chi-square tests of proportions were used to compare differences between participants. To test the evidence of syndemics in this sample, Latent Class Analysis (LCA) was employed. Approaches such as Latent Class Analysis (LCA) and other mixture modeling are suggested as appropriate methods for examining syndemics (Tsai & Venkataramani, 2016). LCA allows for identification of unobserved subgroups in a population with a chosen set of indicators and provides a view of which indicators may occur simultaneously among a population of interest (Lanza & Rhoades, 2013). We hypothesized that perinatal substance use, violence victimization, stress and pregnancy intention would co-occur with historical STI. Before conducting the analysis, it was important to examine measurement invariance to determine if class predictive probabilities would differ by maternal race/ethnicity. To do this, the model was first freely estimated, then constrained, and then a comparison of the G^2 and degrees of freedom was used to determine differences. Upon constraining the model to be similar, probabilities were not significantly different across maternal race/ethnicity ($p < 0.9955$) and measurement invariance was imposed in the LCA model. Model fit was assessed using the G^2 likelihood ratio chi square test, the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC) and entropy (Celeux & Soromenho, 1996; McCutcheon, 1987). Bolded values within the table indicate the predictive probabilities that were highest for any class. Missing data were handled with the maximum likelihood expectation maximization procedure and assumed to be missing at random in PROC LCA. All analysis were performed using SAS V9.4 (Cary, NC).

Results

Table 1 depicts participant characteristics for the analytic sample. Of the 61 YoungMoms participants (age 14–21; mean = 19, SD = 1.67) enrolled between October 2019-February 2020 with available clinical urine samples, most self-identified as Black (53%) and had not given birth previously (54%). A significant portion of participants had previously discussed pregnancy with their partner but had not agreed to get pregnant at that time (43%). Most participants experienced morning sickness during their pregnancy (85%), and roughly half tested positive for cannabis (48%) or tobacco use (51%). A positive result for a previous sexually transmitted infection (STI) was observed in the medical records of 58% of the participants.

A three-class LCA model was best fitting in this sample (Table 2). As seen in Table 3, class one, which comprised most of the sample (52%), was half Black (51%) and had a greater likelihood of STI (65%). Class one was also characterized by higher rates of depressive symptoms (93%), perinatal stress (64%), prenatal tobacco (81%) and cannabis use (65%). In contrast, participants from class two were half as likely to have had an STI (31%) but more likely to be Black (60%), primigravid (100%), have an unintended pregnancy (88%) and be in school (73%). Most of these young women also reported depressive symptoms (70%). The highest risk for STI was seen in class 3 (74%), the group with the highest proportion of white women (38%). Young women in class 3 all reported morning sickness (100%) and were more likely to have a history of IPV (48%), test positive for prenatal cannabis use (74%), and be currently working rather than enrolled in school (61%).

Discussion

The purpose of this study was to examine Syndemic factors associated with STI in a young prenatal cohort. Results suggest that high rates of stress and depressive symptoms co-occurred with prenatal cannabis and tobacco use and risk for STIs in a class that had more Black and Brown pregnant women. These findings are evidence of a syndemic in this group that included traditional syndemic indicators of substance use and depression, but also included unintended

Table 1 Characteristics of participants in the youngMoms study and related syndemic measures 2019–2020, n = 61

Variable	Label	N%	P-value*
Race	Non-Hispanic White	18 (29.5%)	< .0001
	Non-Hispanic Black	32 (53.5%)	
	Hispanic	2 (3.3%)	
	Biracial, Asian, or Other	9 (14.7%)	
Age	Age range 14–21	mean = 19 SD = 1.67	
Currently enrolled in School	Yes	19 (31.1%)	0.0032
	No	42 (68.9%)	
Currently working	Full time	15 (24.6%)	0.0065
	Part time	14 (22.9%)	
	Not working	32 (52.5%)	
First Pregnancy	Yes	33 (54.1%)	0.5221
	No	28 (45.9%)	
Pregnancy Intention	I wanted to get pregnant	12 (19.7%)	.0049
	I kept changing my mind or had mixed feelings about getting pregnant	17 (27.9%)	
	I did not mean to get pregnant	32 (52.5%)	
Pregnancy Intention with Partner	We agreed that we would like me to be pregnant	21 (35.0%)	0.1165
	We talked about having kids together, but hadn't agreed for me to get pregnant	26 (43.3%)	
	We never talked about having a kid together	13 (21.7%)	
Experienced Morning sickness	Yes	52 (85.3%)	< .0001
	No	9 (14.7%)	
PROMIS Depression Score (> 16 indicates depression symptoms)	Mean (SD)	14.58 (6.69)	
Perceived Stress Scale Score (> 8 indicates stress symptoms)	Mean (SD)	10.06 (3.45)	
Experienced physical, sexual or emotional violence from a romantic partner	Yes	10 (17.2%)	< .0001
	No	48 (82.8%)	
Cannabis use during pregnancy	Yes	25 (48.1%)	0.7815
	No	27 (51.9%)	
Tobacco use during pregnancy	Yes	26 (51.0%)	0.8886
	No	25 (49.0%)	
Cannabis & Tobacco co-use	Yes	18 (29.5%)	0.6015
	No	43 (70.5%)	
History of STI in medical record	Yes	33 (57.9%)	0.2332
	No	24 (42.1%)	

*Chi-square test of difference determine significant within group differences

Table 2 Indicators of latent class model Fit

No. of Classes	Log likelihood	Likelihood Ratio G2	Degrees of freedom	AIC	BIC	Entropy
1	−450.20	408.23	6130	434.23	416.68	1.00
2	−433.45	374.73	6116	428.73	485.72	0.82
3*	−419.49	346.82	6102	428.82	515.36	0.87
4	−411.83	331.49	6088	441.49	557.59	0.91
5	−401.17	310.16	6074	448.16	593.82	0.93

*Selected as class with optimal fit

Table 3 Class Predictive Probabilities for YoungMom Study Participants, n = 61

	Class 1, 51.9%	Class 2, 27.8%	Class 3, 20.3%
Currently enrolled in School	0.1097	**0.7318**	0.2516
Currently working	0.4003	**0.5135**	**0.6152**
First Pregnancy	0.3962	**1.000**	0.2824
Pregnancy was not Intended	**0.8322**	**0.8835**	**0.6196**
Experienced Morning sickness	**0.8373**	**0.7731**	**1.0000**
Perceived Stress Scale Score (> 8 indicates stress symptoms)	**0.6360**	0.2281	0.0000
PROMIS Depression Score (> 16 indicates depression symptoms)	**0.9264**	**0.6886**	0.1222
Experienced physical, sexual or emotional violence from a romantic partner	0.0743	0.1188	0.4790
Cannabis use during pregnancy	**0.6508**	0.0000	**0.6295**
Tobacco use during pregnancy	**0.8159**	0.0782	0.3327
History of STI in medical record	**0.6493**	0.3060	**0.7429**
YoungMom Race/Ethnicity			
White	0.2391	0.3375	0.3802
Black	**0.5074**	**0.6039**	0.4600
Hispanic, Biracial & Other	0.2536	0.0586	0.1598

Values above 0.50 are bolded to indicate predominant endorsement of indicator for the class

*Test of measurement invariance did not hold p = 0.7121 alpha = 0.05. Measurement invariance can be imposed in the LCA model, implying that there IS equivalent meaning of the latent classes across groups. There is no need to proceed with the multigroup LCA

pregnancy and experiencing morning sickness. In a class that included more white participants, the women at highest risk of STIs were characterized by morning sickness, partner violence, and current employment rather than being enrolled in school. The classic syndemic in the literature from studies of MSM populations or studies of individuals infected with HIV typically includes substance use, HIV, and violence(Tsuyuki et al., 2017); however, the present study provides rationale that syndemics in pregnancy are unique and can extend beyond those traditionally considered factors to include factors that are important in the lives of pregnant young Black women, including stress, and pregnancy-related factors such as morning sickness. These findings not only have implications for future syndemics research, but also for policies that acknowledge the intersection of mental and physical health concerns during pregnancy.

An understanding of the multiple psychosocial factors that influence risk for adverse outcomes is important, particularly among Black and other minoritized women (Maxson et al., 2016). The increasing rates of prevalent STIs among younger, reproductive aged women and increasing adverse pregnancy outcomes provide significant impetus to understand drivers of infection and determine tailored and appropriate strategies to mitigate acquisition and progression (Folger, 2014). Understanding correlates of STIs in the perinatal period may assist with identifying modifiable factors that may be intervened on such as stress, depressive symptoms, and substance use that significantly impact infections and prevent improving reproductive health outcomes for Black and other minority women (Folger, 2014). Future research should consider how psychosocial factors such as stress and depressive symptoms interact with structural factors to perpetuate syndemic conditions that increase vulnerability for STIs among pregnant minoritized women.

Interestingly, the class reporting the highest probability of STIs also reported the highest rates of partner violence and morning sickness and the second highest rate of prenatal cannabis use. This is consistent with current evidence linking STI, intimate partner violence and substance use(Seth et al., 2010; Teixeira et al., 2019). Women who are victims of partner violence are more likely to be minorities, report their partner engaging in sexual risk behaviors (e.g., inconsistent condom use) and are more likely to test positive for STI (Seth et al., 2010). These concerns continue to persist in younger pregnant populations (38), as demonstrated by the present study where we report that 74% of the women in the class characterized by greater likelihood of partner violence had previously tested positive for a STI (Teixeira et al., 2019). Strategies to reduce violence victimization are paramount and may be aided through syndemic approaches and public policies that address both sexual health, pregnancy intention, substance use in pregnancy, morning sickness, and support mental health.

Syndemic interventions tailored to specific populations have demonstrated significant promise at reducing cocaine use in HIV positive women(Jemison et al., 2019) and there is

a clear need to develop syndemic interventions for pregnant populations (Laurenzi et al., 2020; Lemke & Brown, 2020; Singer et al., 2012). This study is a first step highlighting the utility of using LCA to inform interventions for minoritized pregnant women to reduce the stark health disparities in obstetric outcomes. The investigators are currently collecting data on structural racism and discrimination, experiences of violence, as well as sources of strength and resilience in this population that may interact with behaviors and mental health to promote or prevent disease. Additionally, recent funding announcements from the National Institutes of Health call for research that addresses the multiple social determinants impacting pregnancy and birthing outcomes, such as structural racism(Office of Research on Women's Health, 2021). Research identifying structural racism and discrimination associated with adverse reproductive health will be paramount to informing future policy to reduce health inequities and improving maternal and child health.

Our findings suggest that the classic syndemic factors described in HIV studies may not be transportable to populations of pregnant younger women, including pregnant young Black women. Prior research on adolescent mothers has demonstrated that they are not a homogenous group, and cohort data can be used to identify different risk groups (De Genna et al., 2009; Gillmore et al., 2006; Oxford et al., 2005; SmithBattle, 2005). In this study, the latent class with the largest number of young pregnant minority women were the most likely to report unintended pregnancy and higher rates of depressive symptoms, but also had the lowest probabilities of prenatal substance use, partner violence, and STI. Although preliminary, this may be evidence of some level of protective factors against substance use in pregnancy among minority young women that should be further explored, as was previously demonstrated in a sample of pregnant Latina adolescents (Martinez, Ickovics, et al., 2018; Martinez, Kershaw, et al., 2018).

There is a possibility that factors related to systemic racism and social marginalization are a part of a syndemic for young pregnant Black women. During this vulnerable life stage, societal factors place these individuals at the intersection of multiple pervasive structural and systemic issues such as sexism, racism, and classism. These social and structural influences, conditions in which people live, work, and play, can have significant negative effects on health and contribute to pregnancy-related health disparities. However, data on these experiences were not available for the current analysis. Future timepoints from the longitudinal study from which this data were derived will include measures of interpersonal racism and other forms of discrimination to be evaluated in a syndemic profile. Additionally, studies should examine structural factors and experiences of racism that may play an important role in syndemics for young Black women and potentially explain the high levels of depressive symptoms and stress reported in this study.

While stress related to racial discrimination is broadly implicated in adverse pregnancy outcomes among minority women (Braveman et al., 2017), less is understood about the implications of discrimination on STIs or perinatal substance use. Data on some of the drivers of the syndemic found in this study were included (e.g., anxiety/depression, socioeconomic position) many other factors may not have been measured or do not currently have recommended or validated measurement techniques to assess their impact on health related outcomes (e.g., structural racism)(Chambers et al., 2021). Future studies should continue to explore the influencing factors that lead to the cluster of syndemics and make a case for studies that assist with improving our understanding of the impacts of these systems on individual maternal and child health. Additionally, future work should elucidate how risk factors for perinatal STI and substance use intersect with experiences of discrimination before and during pregnancy with future timepoints from this cohort. Additionally, qualitative assessments of the experiences of young women in the perinatal period will provide context of their lived experiences to develop culturally appropriate and tailored interventions to improve perinatal health and pregnancy outcomes (Hogan et al., 2001). This will include using a Syndemic framework that incorporates a Public Health Critical Race praxis and highlight the importance of examining within group variation instead of external group comparisons (Ford & Airhihenbuwa, 2010).

Limitations

Although this is the first study to examine syndemics of STIs in a US cohort of racially and ethnically diverse young, pregnant participants, there are several limitations to consider. The sample was limited to baseline data from a small number of participants that were recruited prior to the COVID-19 pandemic. Data collection was halted due to restrictions caused by the pandemic but has since resumed. Measures of partner violence were limited to physical and sexual violence and did not include emotional violence or other forms of nonphysical partner violence that may influence pregnancy outcomes. There were very few Latina participants (about 2% of the county population) making it difficult to determine if there were different syndemics among younger pregnant Latina women. Additionally, many variables that may be important Syndemic factors for young pregnant Black women such as discrimination, incarceration, and occupational segregation were not measured in the baseline assessment of the YoungMoms study. The outcome measure, historical STI, was not subject to self-report bias because it was measured using the biological test results listed in

the medical record. However, it was limited to records of tests received at this hospital system, and women may also seek care in other locations. Thus, it likely underestimates the true rates of STI in this sample and more accurately represents STI present during the pregnancy because universal screening is part of the prenatal protocol. Despite these limitations, these results provided early evidence for different syndemics of STIs among younger pregnant women. Measures of race-based discrimination, childhood exposure to trauma, child socioeconomic disadvantage, partner and household characteristics, and pregnancy outcomes that are measured at later phases will further enhance this study of perinatal syndemics.

Conclusion

This study provides evidence of unique syndemics for younger pregnant women that includes pregnancy-specific symptoms, in addition to mental health, substance use, violence and STI. Two different patterns of syndemics for STI were identified in this cohort, suggesting that interventions may need to be tailored for different groups and highlighting the need for more research on syndemics in pregnant peoples. Understanding and collecting data on minority-specific psychosocial stressors during pregnancy is necessary to address racial inequities and further elucidate prevention strategies. STI co-occurred with prenatal cannabis use and morning sickness in both groups of pregnant young women in this study. One group reported higher levels of stress, depressive symptoms and tobacco use and another group was more likely to report experiences of partner violence. Evidence of syndemics in this population provides impetus to further study the longitudinal implications of co-occurring social and structural determinants of pregnancy outcomes and elucidate profiles of risk for adverse outcomes. Understanding syndemic factors is useful to determine appropriate tailored prevention strategies that address pregnancy-specific symptoms, support mental health and healthy relationships, and intervene on substance use for some pregnant young women with higher levels of stress. Policies to promote state and local services supporting healthy pregnancies and addressing syndemic factors such as substance use, anxiety and depression, healthy coping techniques for pregnancy-specific symptoms and supporting healthy relationships in pregnancy are encouraged. Identifying how factors associated with adverse pregnancy outcomes interact differently in specific subpopulations will contribute to development of tailored intervention strategies that promote healthy pregnancies and reduce maternal morbidity.

Author Contribution All authors are responsible for the reported research, are aware and approve this manuscript being submitted to the Maternal and Child Health Journal and have approved the final manuscript as submitted.

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Declarations

Conflict of interest The authors declare that they have no conflicts or competing interests to disclose.

Consent to Participate All participants included in this study provided informed consent prior to inclusion in the study. All study procedures were approved by the University of Pittsburgh Institutional Review Board.

Consent to Publish The authors provide permission to the *Maternal and Child Health Journal* to publish the enclosed work.

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