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EDITORIAL

Incarceration and Mental Health: The Often-Ignored Public Health Crisis

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Welcome to the second issue of the Ohio Journal of Public Health (OJPH). OJPH features articles on public health education, practice, and research occurring in Ohio. In this issue, you will read an Op-Ed about politics and public health, four research articles, three research briefs, and our first public health practice article. One research article and one brief focus on stress, depression, and mental health needs of incarcerated adolescents and adults. I would like to devote part of my editorial to this important public health problem. In Ohio, close to 80,000 individuals are incarcerated in a state or federal prison, local jail, or in the juvenile system.^{1,2} As in the rest of the United States, Ohio's incarceration rates exhibit large racial disparities: among White adults, the rate of incarceration is 289 per 100,000 in the population, whereas the rate is more than five times as high (1,625 per 100,000) among Black adults; among Hispanic adults the rate is also higher (334 per 100,000).¹ There are similar disparities among juveniles in custody, where rates per 100,000 in the population are 98, 560, and 109 for White, Black, and Hispanic youth, respectively.¹

Clemens and colleagues explored the association between depression, stress, and incarceration among participants in the Toledo Adolescent Relationships Study (TARS). This longitudinal cohort study allowed the authors to investigate the impact of incarceration on depression and examine whether stress mediated this relationship. Because of its large sample size and oversampling of Black and Hispanic youth at baseline, TARS provides an incredibly and uniquely rich data set to study incarceration among Lucas County residents as they transition from adolescence to young adulthood. The authors report that previous incarceration was significantly associated with depressive symptoms at follow-up and that this relationship was only partially mediated through stress. Thus, young adults who have a history of incarceration have more symptoms of depression, even after accounting for other confounding variables such as a history of depression, substance use, race/ethnicity, gender, and age.

In the second paper, Wilson et al. examined behavioral health needs among individuals who were processed for non-violent offenses at the Montgomery County Jail between 2016 and 2018. Among the 484 individuals who completed a criminogenic assessment, over half of men and over two-thirds of women had a mental health diagnosis. Moreover, nearly 60% of men and 77% of women had a substance use disorder. Assuming these estimates are representative of other county jails, these results suggest the local jail population in Ohio has significant behavioral health needs, that includes both substance use and mental health treatment.

In Ohio, the Medicaid Pre-Release Enrollment (MPRE) program has been in operation since 2014.³ This collaboration between the Ohio Departments of Medicaid (ODM) and Rehabilitation and Correction (ODRC) provides individuals with Medicaid upon release from prison. Prior to release, participants in the MPRE program are connected with a peer navigator who assists them by stressing the importance of Medicaid and guiding them through

the application process. In 2018, an independent evaluation of this program suggests that it has been successful at connecting individuals with a behavioral health need (substance use or mental health) to care.⁴ Results from the survey of MPRE participants suggest that approximately 30% of individuals reported having at least 7 days of mental health incapacity in the past month and, further, nearly 30% reported past or current substance use treatment since reentering the community. Recent national estimates suggest that only 10% of people with substance use disorder receive treatment.⁴ Importantly, 85% of participants reported that having Medicaid was beneficial to their mental health. In the words of one participant, “[Medicaid has] kept me sober going on 3.5 years now. Seeing that therapist really helped me get over that shame and I was depressed. Seeing a psychiatrist...I never thought about going to the doctor and worrying about my health; I was too busy doing drugs.”⁴

With the continuing national and state-level debates about the costs and value of Medicaid expansion, it is important that public health officials and advocates in Ohio not forget that one of the most vulnerable populations – those formerly incarcerated – benefit tremendously from Medicaid expansion. As reported in the evaluation of the MPRE program, 88% of those receiving substance use treatment stated that having Medicaid made it easier for them to obtain such treatment.⁴ Without Medicaid, mental health and substance use treatment needs could largely be unmet.

The other highlights of this issue include two articles focused on tobacco control. In one, Abide et al. show that Ohio, like other states, has a higher density of tobacco retailers in low-income communities, as well as rural areas (which was not the initial hypothesis). They suggest several policy approaches to addressing this public health problem. In the second, Kauffman et al. report that smoking relapse rates among smokers who call state tobacco quit lines are not related to community contextual or policy factors. In general, smoking cessation rates are low and relapse rates are high among smokers trying to quit. Thus, efforts should focus on all smokers calling state quit lines. Two other research articles published in this issue were conducted on university campuses in Ohio. In the first, Meinzer et al. report on their model of engaging pharmacists in discussions about immunizations, with a particular focus on vaccination for tetanus, diphtheria, and pertussis (Tdap). They show that pharmacists can be effective in encouraging individuals to receive vaccines. In the other paper, Welch et al. surveyed college students on one Ohio campus to determine effective methods for communicating public health emergencies, the example being Toledo's “Do Not Drink” advisory in 2014. The authors report that text messaging is the most effective way to communicate such messages to young adults, which is an important finding for public health officials as they develop plans for how to address local public health emergencies. The remaining two articles in this issue include a research article and a public health practice article. In the former, Kingori et al. present the results of their qualitative study with women

who recently gave birth in Southeast Ohio and report that not all expectancies of pregnancies match reality. The message is that healthcare providers should acknowledge that pregnant women have different expectations and experiences and thus may need tailored care. Finally, the Journal's first public health practice article by Chiyaka et al. presents a model for coordinating care to address chronic illnesses at the community level. The authors describe the program and the steps they took to implement it in Lucas County.

In my last editorial, I noted that OJPH provides an avenue for OPHA to serve as the "Voice of Public Health" in our state. I am grateful to the authors of the papers in this issue for their dedication to these important public health matters in Ohio and their willingness to use the Journal as an avenue to communicate their findings. I continue to be optimistic that the Journal will allow for the development of partnerships between organizations and universities in Ohio to address important public health issues in the state.

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OP-ED

Public Health and Politics

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When I first started working in public health, my supervisor told me that in Ohio, Board of Health members are appointed, rather than elected, to keep politics out of public health. It did not take me long to learn that you really cannot ever separate politics and public health. It is easy to see the impact of politics in some public health programs and policies like healthcare reform, Planned Parenthood, and Tobacco-21 legislation. Politics extend well beyond these highly visible issues, into state and local legislation, policy decisions, and funding allocations.

Politics often reflect the will of those with power (money) and influence. Public health typically lacks both of those. Our grant funding and public employee policies often restrict our ability to lobby lawmakers or run for office, leading many to err on the side of caution and avoid trying to influence politics completely. This even further erodes our ability to advance effective public health policies.

We need to learn to become better advocates for public health policy and systems change, including in areas outside of traditional public health programming. There are many opportunities to advance a Health and Equity in All Policies (HEiAP) approach to policies and legislation that have an impact on the determinants of health, including housing, education, transportation, food insecurity, social justice, and more. The Ohio Public Health Association has championed legislation to incorporate HEiAP into the legislative process, but you can also work to adopt HEiAP in your local communities.

Who we elect and the relationships we build with those officials have an impact on all levels of government. Elected leaders can champion public health issues, like increasing newborn home visitation programs and passing T-21 legislation, or put up barriers to advancing community health, like cutting funding to public health or restricting Medicaid eligibility. While our local boards of health are not elected, they are appointed by elected officials who often select members that reflect their views.

As public health practitioners, it is our responsibility to make our voices heard in order to provide solutions to problems, to promote effective policies, and to express our opinions as the subject matter experts that we are, and as members of the voting public. Step up and run for an elected office because we need more public health professionals in positions that can have a direct impact on public health policy and funding decisions.

I encourage you to be active in your professional associations, build relationships with your elected officials, and advocate for public health. To learn more about advocacy, and how it is different from lobbying, visit www.apha.org/advocacy.

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RESEARCH ARTICLE

Criminal Justice Involvement and Young Adult Health: The Role of Adolescent Health Risks and Stress

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ABSTRACT

Background: Although some studies have found that incarceration is associated with young adults' poor health, confounding factors including adolescent health risks, and mediating influences such as stress have not been examined in the same study. We assessed whether variation in criminal justice system experience (none, arrest only, incarceration) influenced young adults' self-reported depressive symptoms and poor physical health after accounting for prospective risks to health including adolescent health risks. We then assessed whether stress mediated associations between criminal justice involvement and the two health indicators.

Methods: Data are from Toledo Adolescent Relationships Study (TARS) (n =990), which included young adults, age 22-29, who have matured during the era characterized by mass incarceration. The dependent variables included a depressive symptoms scale and self-reported poor health. The adolescent health risks included economic disadvantage, body mass index, delinquency, problems with drugs, and prior depressive symptoms. We considered stress as a mediating variable. Sociodemographic characteristics included race/ethnicity, age, and gender. We used ordinary least squares regression and logistic regression analyses. We tested gender, race/ethnicity, and age interactions.

Results: In multivariable models, incarceration, and adolescent health risks (economic disadvantage, prior depression, problems with drugs) were associated with young adults' depressive symptoms, and stress was a mediating influence. Adolescent delinquency and stress, but not incarceration, were significantly associated with young adults' self-reported poor health.

Conclusion: This study provided a more nuanced understanding of incarceration and health by accounting for several key confounding factors and testing stress as a mechanism underlying the association. Care for prisoner health during and after incarceration is important for successful reintegration.

Key words: Incarceration; Depression; Stress; Health

INTRODUCTION

In the U.S. many individuals have come in contact with the criminal justice system. Mass incarceration refers to the reality that a vast population of men and women are confined in federal and state prisons as well as local jails, and an even larger population has experienced arrest.¹ Mass incarceration, disproportionately affects Black and Hispanic young men.² Ohio is not immune to these trends in criminal justice contact. On average, 224,000 individuals are arrested in Ohio each year and in 2017 the Ohio incarceration population was around 80,000. Much like national trends, incarceration in Ohio disproportionately affects individuals of color.³ Although 81% of Ohio's population is White, around 43% of incarcerated individuals in Ohio are Black and 5% are Hispanic. Thus, the criminal justice system reflects racial and socioeconomic inequality.⁴

The large number of individuals arrested as well as incarcerated in Ohio necessitates understanding the collateral health consequences of criminal justice contact. Early research argued that incarceration may improve health because it provided access to a modicum of health care services.⁵ Yet, more recently, some researchers have concluded that incarceration negatively influenced adult men's physical and mental health.⁶ Other studies have emphasized that it is important to include criminal activity and sociodemographics when analyzing criminal justice system effects because these background factors may also compromise health outcomes.⁷ However, in a recent study that included men's and women's criminal activity and sociodemographic background, incarceration remained a significant predictor of health outcomes.^{7,8} We argue that additional research is needed

to explore the underlying mechanism linking incarceration and health outcomes. One compelling explanation for the association between criminal justice contact and health outcomes is that incarceration is a stressor that contributes to deteriorated health post-release.⁸ Yet prior studies have not empirically examined general stress as a mechanism.⁹ Additionally, although most studies have focused on incarceration, some researchers have argued that even minor encounters with police and increased police presence in communities negatively influence health outcomes.¹⁰ Arrest labels individuals, which may lead to a downward spiral including hindering educational and employment opportunities¹¹ that influence health outcomes.¹²

We argue that the association between criminal justice system involvement and the probability of poor physical and mental health may be partially due to prior health risk factors including childhood economic disadvantage.¹² Economic disadvantage is associated with poor health and arrest in adulthood.¹³ Ross found that economic disadvantage led to greater frequency of depressive symptoms¹⁴ and others found it to be associated with earlier mortality.¹³ These effects may be especially pronounced for mothers released from prison.¹⁵ Thus, the effects of early economic disadvantage likely influence physical and mental health and should be incorporated in models examining associations between criminal justice contact and health outcomes.

Adolescent health risks also influence health outcomes during young adulthood and should be considered in studies examining the association between criminal justice contact and health. Along with poverty, adolescents face a number of long-term health risks from their behavior. For example, adolescent de-

linquency has been associated negatively with health in adulthood.¹⁶ Perhaps a more persistent health risk behavior is drug use during adolescence. A history of drug problems predicted both diminished cognitive capacity and cardiovascular problems in adulthood.¹⁷ Similarly, marijuana and cocaine use correlates with adverse mental health outcomes.¹⁸ Longer drug use careers and poorer health increased the probability that incarcerated drug users experienced unmet health needs.¹⁹ Adolescent substance abuse is related to both increased chance of incarceration and psychiatric disorders, thus the adverse effects of drug use may be additionally compounded by incarceration.¹⁸ Finally, some basic indicators of poor health in adolescence are also predictive of poorer health in adulthood. For example, elevated body mass index (BMI) predicted lifelong struggles with obesity and increased odds of earlier mortality.²⁰ Likewise, adolescent depression is one of the strongest predictors of later life depression.²¹ As highlighted, numerous high-risk adolescent lifestyle factors and health indicators are linked to decreased health through adulthood.²²

In summary, there are several gaps in the literature that we attempt to address in the current study. First, although some studies have found that incarceration is associated with young adults' poor health, confounding factors including adolescent health risks, and mediating influences such as stress have not been examined in the same study. Second, some researchers have argued that even minor encounters including being arrested negatively influence health outcomes. Our study assessed whether criminal justice system experience (none, arrest only, incarceration) influenced young adults' self-reported health and depressive symptoms after accounting for prospective risks to health including childhood poverty, and adolescent health and lifestyle risks (delinquency, problems with drugs, BMI, earlier depression). We then assessed whether stress mediated associations between criminal justice involvement and health. We based analyses on panel data from an Ohio population-based sample of young adults (age 22-29 years) from the Toledo Adolescent Relationships Study (TARS) (n =990). Incarceration rates in Lucas County, Ohio are lower than the average in Ohio as a whole. Nevertheless, each year approximately 600 individuals are admitted to prison in Lucas County and the prison population has remained around 2000 since 2010.

METHODS

Setting and Design

The TARS initially was based on a stratified random sample of seventh, ninth and eleventh graders in the years 2000 and 2001 in Lucas County, Ohio. Census data showed that Lucas County is similar to national statistics regarding income, race, and education.²³ We collected four subsequent waves of data as individuals transitioned to adulthood, and IRB approval was received for each wave.

Participants

The baseline sample consisted of 1,321 individuals between age 12 and 18 years. At the fifth interview in 2012 respondents were between age 22 and 29 years. We retained 1,021 individuals for the fifth interview. Respondents completed the survey primarily in their homes using a computer assisted interview procedure (first interview) and on-line (fifth interview). We surveyed primary caregivers, usually mothers, at the first interview separately from adolescents. The TARS drew from school rosters, but respondents did not have to be in school or regularly attend school to be included.²³ We oversampled Black and Hispanic respondents. We excluded respondents missing on self-reported health (n=6) or depression scale items at the fifth interview (n=2). We also excluded respondents who reported their race as "other" (n=23) because the sample size was too small for multivariable analyses. This resulted in a final analytic sample of 990. In our analytic sample, only two variables had missing values (stress n=1; and problems with drugs n=2). We estimated these missing values in descriptive analyses using single imputation of the data, and

multiple imputation with 5 iterations for multivariable analyses. We conducted all analyses using SAS 9.4 in 2018.

Measures

Dependent Variables

Depressive Symptoms. We measured depressive symptoms with an eight-item version of the Center for Epidemiological Studies Depressive Symptoms (CESD) scale.²⁴ We asked how often in the last week had respondents felt that each statement was true: (1) "felt depressed"; (2) "everything was an effort"; (3) "felt sad"; (4) "couldn't get going"; (5) "felt lonely"; (6) "couldn't shake off the blues"; (7) "trouble sleeping or staying asleep"; and (8) "couldn't keep focused." The mean scale ranged from 1 (never) to 8 (every day) ($\alpha = 0.90$). Due to skewness, we log transformed depression in multivariable analyses.

Poor Health. We measured self-reported poor health with the item: "Overall, how would you rate your health?" We dichotomized responses into poor or fair health (11.5%) and not in poor health (excellent/very good/good, 88.5%). Dichotomizing self-reported health has precedence in the literature, and yields similar results to more sophisticated categorical measure of health,²⁵ and correlates highly with more specific self-reported and objectively measured conditions.¹³

Independent variables

Criminal Justice Involvement. In response to the lack of comprehensive measures of criminal justice system involvement,²⁶ we measured incarceration history with a trio of assessments. First, respondents indicated each arrest and whether that resulted in jail time. Second, at each interview respondents provided their residency, and if they selected "in prison," we coded them as incarcerated. Finally, on the parent questionnaire, we asked caregivers how many times their child "was placed in a juvenile detention facility." If caregivers responded affirmatively, we coded respondents as incarcerated. We constructed criminal justice involvement with the following mutually exclusive categories: never arrested (63%), arrested only (27%), and incarcerated (9%).

Adolescent Health Risks. We used items from the parent's questionnaire at the first interview to measure childhood economic disadvantage. Some scholars have recommended that measures of poverty should capture inequality and disadvantage as the dynamic process it is rather than more static measures such as household income or education.²⁷ Adapting this strategy, we measured economic disadvantage with an index of items. We summed four dichotomous variables: (1) mother has less than high school education; (2) family ever received public assistance; (3) unemployment is a problem in the neighborhood; and (4) there were times when there was not enough food in the house. This count variable of indicators represents the disadvantaged experiences of respondents during adolescence.²⁸

We assessed several adolescent health risks at the first interview including BMI, depression, juvenile delinquency, and problems with drugs. We calculated BMI, which we standardized for juveniles according to CDC age guidelines²⁹ and then centered the value in multivariable analyses to give the variable an interpretable zero. In multivariable analyses, we included quadratic BMI to account for non-linearity. We measured juvenile delinquency by asking how often respondents committed each of the following: (1) "steal something less than \$50"; (2) "steal something more than \$50"; (3) "damage property"; (4) "carry gun"; (5) "attack someone"; (6) "sell drugs"; (7) "break into a building;" and (8) "drunk in a public place."³⁰ Responses ranged from 1 (never) to 9 (daily) ($\alpha = 0.75$). The mean juvenile delinquency score was 0.29 (range = 1 to 9). We measured problems with drugs by asking, "How often in the past 2 years have you experienced the following because of drug use: (1) "not felt good next day"; (2) "unable to do your best"; (3) "problems with partner"; (4) "hit family member"; (5) "gotten into fights"; (6) "problems with friends"; (7) and "gotten into regrettable sexual situation."³¹ The scale mean was 1.59, and ranged from 1 (never) to 8 (daily) ($\alpha = 0.87$).

For models predicting depression, we measured early depressive symptoms at baseline, similar to the dependent variable, using the eight-item (CESD) scale²⁴ (mean = 2.3, range = 1 to 8) ($\alpha=0.83$).

Stress. At the fifth interview, we asked respondents about stress that they experienced due to the following: (1) family members' health; (2) employment; (3) living arrangements; (4) school; (5) money; (6) romantic relationship; (7) parents; (8) other family members; and (9) friends. The scale mean was 2.08 and the range was 1 (not at all stressed) to 5 (extremely stressed) ($\alpha=0.83$).

Sociodemographic Characteristics. We controlled for race/ethnicity, which we classified as non-Hispanic White (67.5%), non-Hispanic Black (21.5%), and Hispanic (11%) (measured at the first interview). We also controlled for age at the fifth interview (mean = 25, range = 22 to 29), and self-reported gender (46.1% male and 53.9% female).

Statistical Analysis

We tested whether arrest or incarceration negatively influenced the health of individuals controlling for adolescent health adverse behavior, childhood economic disadvantage, and stress. First, we tested for differences of means/proportions of each independent variable among those with no criminal justice contact, arrested only, and incarcerated using t-tests and chi-square tests (for categorical variables). We conducted logistic and ordinary least squares regression, respectively, to estimate the effects of arrest and incarceration on depression and physical health. We included incarceration and sociodemographic characteristics (model 1), added childhood disadvantage and adolescent health risks (model 2), and then added stress (model 3) We used the Sobel test

to assess whether stress mediated the influence of incarceration on the health outcomes. The Sobel test is a method to determine whether the reduction in the effect of an independent variable (i.e., incarceration) is statistically significant after including a mediating variable (i.e., stress).

RESULTS

Summarizing the descriptive statistics in Table 1, individuals who had experienced incarceration reported more frequent depressive symptoms compared to individuals who were arrested only, and those who had never been arrested. The frequency of depressive symptoms did not differ significantly among those who experienced arrest only and those with no criminal justice contact. We found that a higher proportion of individuals who were incarcerated, compared with having been arrested only and having no criminal justice contact, reported poorer physical health. Self-reported poor health was not statistically different for those who have and have not been arrested.

On average, individuals who were arrested or incarcerated had increased health risk factors (e.g., prior depression, economic disadvantage, higher BMI, delinquency, problems with drugs) compared to individuals who had never been arrested. Additionally, compared with individuals who have never been arrested, individuals who have been incarcerated, and those who have been arrested only, reported significantly higher delinquency scores. Similarly, individuals who have been incarcerated and those who have been arrested only, reported greater odds of problems with drugs during adolescence, compared to those who have never been arrested. Lastly, those who experienced incarceration exhibited higher general stress than those who experienced arrest only and those with no criminal justice system contact.

Table 1. Descriptive Statistics and Group Comparisons for Criminal Justice Involvement

	Full Sample	Criminal Justice Involvement		
	n=990	Never Arrested n=606	Arrested n=260	Incarcerated n=124
	Mean±SD/ Percentage	Mean±SD/ Percentage	Mean±SD/ Percentage	Mean±SD/ Percentage
Dependent Variables				
Depressive symptoms (log transformed)	0.73±0.46	0.70±0.47	0.73±0.47	0.97±0.44 ^{ab}
Poor health (%)	11.5%	10.6%	11.6%	17.4% ^{ab}
Independent Variables				
Economic disadvantage				
0 reported experiences	40.0%	47.7%	34.9% ^a	13.3% ^{ab}
1 reported experience	22.3%	21.6%	21.6%	27.3% ^{ab}
2 reported experiences	21.2%	18.4%	23.5% ^a	29.7% ^{ab}
3+ reported experiences	16.5%	12.3%	20.1% ^a	30.7% ^{ab}
Adolescent Depression	2.30±1.10	2.30±1.14	2.29±1.05	2.38±1.22
BMI	0.00±5.44	0.01±5.70	-0.24±5.31 ^a	0.35±5.67 ^{ab}
Delinquency	0.29±0.51	0.21±0.42	0.40±0.57 ^a	0.54±0.70 ^a
Drug use	1.12±0.52	1.07±0.31	1.16±0.52 ^a	1.29±0.58 ^a
Mediator				
Stress	2.11±0.71	2.09±0.70	2.06±0.73	2.34±0.80 ^{ab}
Sociodemographic factors				
Race/Ethnicity				
White	66.5%	72.1%	63.8% ^a	44.4% ^{ab}
Black	22.0%	17.7%	25.8% ^a	35.5% ^{ab}
Hispanic	11.1%	10.1%	10.2% ^a	20.2% ^{ab}
Age	26.38	26.44±1.86	26.17±1.18	26.36±1.55
Gender				
Male	46.2%	37.5%	58.9	62.1% ^a
Female	53.8%	62.5%	41.1	37.9% ^a

Source: Toledo Adolescent Relationships Study 2000-2012

Dependent variables collected in fifth interview (2011-2012)

Independent variables collected at the first interview (2000-2001)

Criminal justice involvement categories are retrospective from the fifth interview (2011-2012)

Note: ^a Value is significantly different from the never arrested group at $p<.05$

^b Value is significantly different between arrested and incarcerated groups at $p<.05$

Results for Depressive Symptoms

Table 2 includes the unadjusted and multivariable OLS regressions of log transformed depression on criminal justice system involvement, adolescent health risks, stress, and sociodemographic characteristics. The bivariate (unadjusted) analyses indicated that being arrested, and being incarcerated, compared to never having been arrested, are associated with more frequent depressive symptoms. All of the adolescent health risks, stress, and identifying as Black compared to White were associated with greater frequency of depressive symptoms. In model 1, having experienced incarceration, compared to having never been arrested, was associated with greater frequency of depressive symptoms net of sociodemographic characteristics. Identifying as Black compared to White, and women compared with men reported greater frequency of depressive symptoms.

Model 2 demonstrated that with the inclusion of adolescent health risks and sociodemographic characteristics, incarceration was associated with depressive symptoms. More economic disadvantage experiences and depressive symptoms during adolescence were associated with greater frequency of depressive symptoms in young adulthood.

In model 3, stress was associated with depression net of the other coefficients. The effect of incarceration decreased when accounting for stress indicating that incarceration affects mental health partially through stress. Results of a Sobel test for mediation showed that the coefficient for incarceration significantly decreased in magnitude after including stress in the model.

Results for Self-Reported Poor Health

Table 3 included the unadjusted and multivariable logistic regression of self-reported poor health on criminal justice system involvement, adolescent health risks, stress, and sociodemographic characteristics. The bivariate (unadjusted) analyses indicated that economic disadvantage experiences during adolescence and stress during young adulthood were associated with higher odds of reporting poor health in young adulthood. Model 1 included criminal justice contact and sociodemographic characteristics. Net of sociodemographic controls (race, gender, and age), the association between incarceration and the probability of reporting poor health approached significance. None of the sociodemographic characteristics were significantly associated with self-reported poor health during young adulthood.

In model 2, higher BMI scores during adolescence were not associated with self-reported poor health during young adulthood net of the other variables in the model. The quadratic term continued to be insignificant. In model 3, stress was associated with higher odds of reporting poor health.

To assess whether the effect of arrest only is similar or different to incarceration, we changed the reference group in each model from never arrested to incarcerated (not shown). The effect of arrest was significantly lower than the effect of incarceration on self-reported poor health and depression, and did not differ from the effect of no criminal justice contact. That the arrested only coefficients were not significantly different from the never arrested coefficients demonstrated that any effect on health appears triggered by incarceration.

Table 2. Unadjusted and Multivariable OLS Regression of Depression on Criminal Justice Involvement, Sociodemographic Characteristics, Child Disadvantage, Adolescent Health Risks and Stress

	Unadjusted		Model 1		Model 2		Model 3	
	b	(SE)	b	(SE)	b	(SE)	b	(SE)
Intercept			0.756***	(0.21)	0.594*	(0.26)	-0.310	(0.24)
Criminal Justice System Involvement^b								
Arrest (ref=never arrested)	0.032*	(0.02)	0.027	(0.03)	0.016	(0.03)	0.012	(0.03)
Incarceration	0.226***	(0.02)	0.214***	(0.05)	0.166***	(0.05)	0.128*	(0.04)
Adolescent Health Risk Factors^c								
Economic Disadvantage ^d (ref=no disadvantage)								
1 reported experience	0.049**	(0.04)			0.015	(0.04)	0.022	(0.03)
2 reported experiences	0.223**	(0.04)			0.143***	(0.04)	0.129***	(0.04)
3+ reported experiences	0.305***	(0.07)			0.233**	(0.08)	0.232**	(0.07)
Depression	0.106***	(0.01)			0.094***	(0.01)	0.063***	(0.01)
BMI	0.008**	(0.00)			-0.011	(0.01)	-0.014	(0.01)
BMI ²	0.000*	(0.00)			0.000	(0.00)	0.000	(0.00)
Delinquency	0.061*	(0.03)			-0.004	(0.01)	-0.013	(0.01)
Drug problems	0.098	(0.04)			0.053*	(0.04)	0.083*	(0.04)
Mediator								
Stress	0.305	(0.02)					0.286***	(0.02)
Sociodemographic Characteristics^c								
Race/ethnicity (ref=non-Hispanic white)								
Black	0.160***	(0.04)	0.099***	(0.04)	0.086*	(0.04)	0.102*	(0.04)
Hispanic	0.068	(0.05)	0.036	(0.05)	-0.010	(0.05)	-0.008	(0.04)
Gender (ref=male)	0.020	(0.03)	0.067	(0.03)	0.016	(0.03)	0.008	(0.03)
Age	0.025	(0.05)	0.001	(0.01)	-0.015	(0.01)	-0.00	(0.01)

Source: Toledo Adolescent Relationship Study (TARS) 2001-2012

Notes: *p<.05, **p<.01, ***p<.001

^a Depression is a log transformed mean scale derived from the CESD (Radloff 1979)

^b Measured at the fifth interview (2012)

^c Measured at the first interview (2001)

^d Measured with the parent questionnaire at the first interview (2001)

Table 3. Unadjusted and Multivariate Logistic Regression of Poor Health on Criminal Justice Involvement, Sociodemographic Characteristics, Child Disadvantage, Adolescent Health Risks and Stress

	Unadjusted		Model 1		Model 2		Model 3	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Criminal Justice System Involvement^b								
Arrest (ref=never arrested)	1.11	(0.69, 1.73)	1.14	(0.71, 1.83)	1.14	(0.70, 1.86)	1.15	(0.70, 1.90)
Incarceration	1.67	(0.99, 2.86)	1.69	(0.97, 2.96)	1.49	(0.82, 2.72)	1.33	(0.72, 2.47)
Adolescent Health Risk Factors^c								
Economic Disadvantage ^d (ref=no disadvantage)								
1 reported experience	1.63	(0.94, 2.82)			1.49	(0.84, 2.64)	1.49	(0.83, 2.67)
2 reported experiences	2.61	(1.56, 4.37)			2.33	(1.32, 4.10)	2.24	(1.26, 4.00)
3+ reported experiences	3.23	(1.36, 7.64)			3.36	(1.33, 8.50)	3.50	(1.36, 9.04)
BMI	1.08	(1.05, 1.12)			1.06	(0.89, 1.27)	1.05	(0.88, 1.26)
BMI ²	1.01	(1.01, 1.01)			1.00	(0.99, 1.00)	1.00	(0.99, 1.00)
Delinquency	1.05	(0.72, 1.53)			1.04	(0.86, 1.27)	1.01	(0.83, 1.23)
Drug use	0.92	(0.56, 1.53)			0.70	(0.34, 1.43)	0.71	(0.34, 1.48)
Mediator								
Stress	2.17	(1.69, 2.77)					1.96	(1.51, 2.53)
Sociodemographic Characteristics^c								
Race/ethnicity (ref=white)								
Black	1.44	(0.91, 2.27)	1.34	(0.85, 2.15)	0.89	(0.53, 1.49)	0.849	(0.49, 1.46)
Hispanic	1.06	(0.56, 2.04)	0.99	(0.51, 1.91)	0.69	(0.34, 1.38)	0.671	(0.33, 1.37)
Gender (ref=male)	1.24	(0.84, 1.84)	1.34	(0.89, 2.01)	1.23	(0.80, 1.87)	1.181	(0.77, 1.82)
Age	1.02	(0.92, 1.14)	1.03	(0.92, 1.14)	0.99	(0.88, 1.10)	1.021	(0.91, 1.15)

Notes: Multivariate results for self-reported health using Toledo Adolescent Relationship Study (TARS) 2001-2012

^a Better than poor health was treated as the reference group when determining the self-reported health ORs

^b Health, criminal justice involvement, and stress measured at the fifth interview (2012)

^c Adolescent Health Risks and sociodemographic controls measured at the first interview (2001)

^d Adolescent economic disadvantage measured with the parent questionnaire at the first interview (2001)

DISCUSSION

Incarceration was positively associated with young adults' self-reported depressive symptoms. Additionally, adolescent health risks (economic disadvantage, earlier depression, problems with drugs) were associated with greater frequency of depressive symptoms. Black compared to White young adults, as well as young adult women, reported more frequent depressive symptoms. Stress mediated the association between incarceration and frequency of depressive symptoms. This finding of mediation supports arguments made by scholars who have posited that the stressfulness of incarceration is likely to overwhelm individuals' coping abilities and ultimately leave them more depressed than prior to incarceration.² We did not find that incarceration was associated significantly with young adults' self-reported poor physical health controlling for adolescent health risks and socio-demographic characteristics. Yet, adolescent BMI and stress were associated with young adults' self-reported poor physical health.

Although studies have begun to explore whether the effects of the criminal justice system extend to early procedures like arrest or police contact, we found no evidence of deleterious effects of arrest for depression (similarly arrest was not significantly associated with poor physical health). Even in supplementary analyses (not shown) which tested experiencing arrest without considering incarceration, there was no significant association between arrest and any health outcomes. It may be the case that being arrested multiple times is damaging to both physical and mental health. An interesting 'non-finding' is that adolescent delinquency and problems with drugs were not associated with young adults' reports of poor health. It is likely that persistent long-term problems with drugs would negatively affect health outcomes.

The results of this study support the need to continue developing theory and research in the area of stress processes and cumulative disadvantage, and how these affect health consequences of incarceration. As demonstrated by our analyses, stress mediated the effects of incarceration experience on depressive symptoms.

Importantly, the effect of childhood economic disadvantage on depression remained significant in all of the models suggesting that earlier economic disadvantage has long-term consequences for young adults' mental health.

We have contributed to the literature on the association between incarceration and health in several ways. Previous studies have suggested that prison conditions negatively impact individuals' health even after release from prison. Recently, studies established a longitudinal association between juvenile incarceration and long-term health problems and depression.⁷ However, it is plausible that incarceration is not the cause of poor health, but rather reflects selection into poor health by individuals who engaged in earlier health compromising behaviors, which we referred to as adolescent health risks, and who were disadvantaged by their childhood economic standing. Additionally, other scholars hypothesized that the negative effects of incarceration and arrest on health act through the increased stress of the prison environment.^{8,9} Although researchers presume stress is the mechanism through which incarceration affects well-being,⁸ in this paper we tested this relationship.

The arrest and incarceration measures are retrospective. This limitation is potentially problematic because the dependent variables assessed health at the time of the interview. There may be important health consequences for individuals who spent a short period of time in jail and those sentenced to longer duration prison terms. Future data and studies can further address this with a more detailed look at number of arrests, the timing of incarceration experiences, and the duration of incarceration experiences to determine more accurately whether these events triggered increases in stress. Nevertheless, the findings of some differences for depression due to incarceration call attention to their sizable consequences even in the short run. Future research should also focus more so on race/ethnicity differences in incarceration rates. For example, future studies should confirm whether drug offense arrests/incarceration effects on health outcomes differ for White,

Black, and Hispanic young adults.³² Unfortunately, our data do not permit us to assess this question.

Studies of incarceration and health have often used more in-depth measures of health conditions than the single item self-report poor health measure used in this study. Nevertheless, some scholars have concluded that self-reported overall health is an adequate if not superior way to measure health in survey research. A self-reported measure may be the optimal way to capture health disparities in younger adults because it is highly correlated with objective measures of more serious conditions.²⁵ Other studies have focused primarily on older adults or adolescent health. The present study focused on adults who should be in excellent physical health. Thus, finding small effects on health may be indicative of future health problems. Furthermore, additional research is needed on the interplay of the stress indicators. Although they are correlated well enough to combine into a single measure ($\alpha=0.83$), this does not permit us to elaborate on more specific pathways. We conceptualized this measure of stress as manifestations of proliferating stress via the stress process, however, other pathways are plausible.

The present study combined juvenile and adult criminal justice experience into singular categories that indicated any criminal justice experience. Supplemental analyses of the TARS data did not reveal any significant differences between those who experienced the criminal justice system as juveniles and those who experienced arrest or incarceration as adults. The present study did not focus on racial disparities in the processes we examined. Researchers have repeatedly shown that racial disparities exist in the experience of economic disadvantage, exposure to incarceration, and a range of health outcomes.³² Similarly, with regard to BMI there are differences by race/ethnicity. Supplementary analyses of these data identified some differential processes based on race (results not shown). The findings on stress as a mediating mechanism were not significantly different from the ones presented in the present study while controlling for race. Thus, an exploration of racial patterns would likely be fruitful avenue for a future research project. Our next step is to determine why the interrelationships explored above might be similar or vary based on race/ethnicity. Gender differences in health (e.g., depression) and odds of system exposure also suggest the need to explore similarities and differences in the nature of these pathways. The relatively limited statistical power of the incarcerated female sample prevented a thorough exploration of these differences.

Several of these limitations (relatively young age of the sample, short time window), are likely to bias the study against our results. Thus, this study represents a rather conservative test of the proposed relationships. However, with a great deal of possible unmeasured or unexplored biases, results should be interpreted cautiously. Still, the striking differences between the incarcerated and not incarcerated are worthy of future scholarly consideration.

PUBLIC HEALTH IMPLICATIONS

Our results highlight the need to assess adolescents' experiences that increase the probability of criminal justice contact. Findings on self-reported poor health indicated that incarceration is not significantly associated with poor self-reported physical health when accounting for other important factors. Importantly this study may be too early in the lifespan to gauge true deleterious effects on self-reported physical health. In contrast, incarceration influenced depression net of the adolescent lifestyle and disadvantage factors. Although it is likely that physical health and well-being are influenced by multiple factors, and not solely from incarceration, criminal justice agencies have a responsibility and opportunity to provide health programs in prison and support for health education post-release.³³ Ohio's leadership has proclaimed a commitment to be a leader in criminal justice reform amidst mass incarceration in the state.³⁴ Among the much needed reforms are additional mental and physical healthcare services pro-

vided to prisoners. Ohio has committed previously to programs aimed at providing mental health services to ex-offenders.³⁵ Given the significant effects on depression found in this study focusing on emotional well-being and coping with stress should make supporting such programs a priority. Supporting young adults' mental and physical health post-release will increase the likelihood that this period will lead to efficacious actions including gainful activity and reduced odds of continued reliance on ineffective coping strategies such as substance use. Earlier additions to Ohio reentry programs aimed at reducing prison and jail populations are promising particularly for the juvenile justice system,³⁶ but further reform will enhance the chances of adult offenders experiencing better mental health after release. Setting our study in Lucas County provides an example of a typical American city, which sets the stage for generalizability beyond the state of Ohio as well.²³ Ultimately, by addressing these root causes of problems with drugs and other criminal activities, these changes may help to alleviate the rising incarceration rates in Ohio.

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RESEARCH ARTICLE

The Relationship between Tobacco Retailer Density and Neighborhood Demographics in Ohio

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ABSTRACT

Introduction: Studies from various parts of the country suggest that tobacco-related health disparities are exacerbated by disparities in the distribution of tobacco retailers (convenience stores, tobacco shops, etc.). The purpose of the present study was to use advanced spatial modeling techniques for count data to estimate current disparities in tobacco retailer density in Ohio.

Methods: We identified and geocoded 11,392 tobacco retailers in Ohio. Next, we obtained census tract-level information on race/ethnicity, poverty, and age and obtained county-level information on whether an area was Urban, Suburban, or Rural. Finally, we used negative binomial generalized linear models, adapted for residual spatial dependence, to determine the association between per capita tobacco retailer density and demographic characteristics—summarized by adjusted rate ratios.

Results: There were more (from 1.4-1.9 times as many) retailers per capita in high-poverty vs. low-poverty tracts. Poverty also interacted with age: the association between high poverty and high retailer density was stronger for tracts with a low youth population. Density was also greater in tracts with a high (vs. low) prevalence of African Americans (1.1 times as many) and Hispanics (1.2 times as many). Finally, density was generally greater in rural (vs. suburban or urban) tracts, although the effect was modified by a three-way interaction: density was particularly high for rural tracts that also had both a high prevalence of poverty and a low youth population.

Discussion: Overall, our findings indicate that Ohio's vulnerable populations are exposed to a greater per capita density of tobacco retailers. There is a need for state and local-level tobacco control policies that will improve equity and reduce health disparities.

Key words: Tobacco retailer density; disparities; spatial modeling

INTRODUCTION

In the United States, smoking remains the leading cause of preventable morbidity and mortality,¹ with more than 480,000 deaths occurring each year as a result of cigarette smoking.² Smoking is a particular health concern in the state of Ohio, where the smoking rate is the sixth-highest in the country: 22.5% of Ohio adults are current cigarette users, compared to a prevalence of 17.1% nationally.³

Of additional public health concern is the fact that smoking prevalences are not uniform across the population. Rather, paralleling national trends,⁴ Ohio sees higher smoking rates among low-income populations and certain racial/ethnic minority groups.⁵ Furthermore, both nationally⁶⁻⁸ and in Ohio,⁹ there is a higher prevalence of adult and adolescent smokers in rural areas, compared to non-rural areas. These types of demographic differences in smoking prevalences later translate into disparities in tobacco-related disease. For example, African American individuals in the U.S., particularly African American men, have the highest rates of lung cancer incidence and mortality.¹⁰

Numerous studies have illustrated how the relationship between the density of tobacco retailers (e.g., convenience stores, grocery stores, tobacco shops) and neighborhood demographics further tobacco-related health disparities. Specifically, research with multiple cities and counties demonstrates that tobacco retailer outlets are more heavily concentrated in marginalized communities, including those with higher proportions of racial/ethnic minorities and those with lower income levels.¹¹⁻¹³ There is also some evidence to suggest that tobacco retailer density is greater in

urban communities.¹⁴ These disparities in tobacco retailer density are, in turn, associated with tobacco use.^{15,16} For example, higher tobacco retailer concentration within one mile of youths' homes is associated with higher smoking frequency.¹⁷ Young adults are more than three times as likely to start using non-cigarette combustible tobacco products if they live in areas with high tobacco retailer density.¹⁸ Moreover, high tobacco retailer concentration for youth is associated with increased exposure to point-of-sale tobacco advertising and the belief that smoking looks cool.¹⁹ Additionally, a high prevalence of tobacco retailers in a community hinders tobacco cessation among adults.²⁰

Compounding the problem of density is the problem that the quantity of tobacco advertising differs across communities. Disparities in point-of sale marketing exist, as greater amounts of tobacco advertisements per store are found in low-income, African American neighborhoods.^{21,22} A high volume of tobacco advertising is a public health concern because point-of-sale marketing exposure can have a powerful impact on youth, distorting perceptions about the availability and popularity of tobacco,²³ increasing curiosity about tobacco use,²⁴ and increasing the likelihood of smoking initiation.²⁵ For adults, tobacco marketing exposure is associated with more frequent cravings to smoke and greater difficulty quitting.²⁰

The purpose of this study was to estimate current disparities in tobacco retailer density in Ohio. Previous research had primarily investigated disparities in tobacco retailer density at the city or county level. By researching these disparities at the state level, we would have a more thorough understanding of the distri-

bution of tobacco retailers throughout a large area that varies widely in its demographic and geographic makeup. Our first hypothesis was that tobacco retailer density would be more prevalent in low-income areas. Our second hypothesis was that there would be a higher concentration of tobacco retailers in high racial and ethnic minority neighborhoods (specifically, African American and Hispanic). Our third hypothesis was that tobacco retailer density would be higher in urban areas.

In testing these hypotheses, our methodology incorporated two of the latest approaches for investigating tobacco retailer density. First, although past literature primarily focused on the density of conventional tobacco retailers, such as convenience stores, gas stations, and grocery stores, this study additionally examined the density of alternative tobacco retailers, such as vape and hookah outlets. Second, our analyses used spatial statistical methods to account for spatial autocorrelation in the retailer counts. When estimating tobacco retailer density, there is concern over spatial dependence—that is, that nearby retailer counts cluster together. The presence of spatial dependence can violate underlying analytical assumptions of independence of observations and can produce underestimated standard errors, leading to inaccurate conclusions from confidence intervals and hypothesis tests. We therefore used a spatial modeling approach, which has been shown to sufficiently adjust for spatial autocorrelation in retailer density research.^{11,12,26}

METHODS

Identification of Tobacco Retail Outlets

Gathering Cigarette Retailers

A list of Ohio-based cigarette establishments was compiled from September 2017 to December 2017. Names and addresses of all establishments with active cigarette licenses were obtained from each of Ohio's 88 county auditor offices. In instances where an address was repeated in our list (generally from a change in business ownership and thus a new cigarette license), the duplicate address was removed. In instances where an address was reported as a street intersection, locations were translated into full addresses through cross-referencing of google map street view. A subset of establishment addresses was reported without zip codes, a portion of the address necessary to properly geocode. In the case of missing zip codes, the addresses were completed through a first round of rough geocoding followed by batch reverse geocoding and exporting of the zip code. Following these steps, we had an initial list of 11,109 cigarette retailers. Retailers included venues such as gas stations, convenience stores, grocery stores, and tobacco shops.

To assess the accuracy of our list of cigarette retailers (“groundtruthing”), a random sample of 10% of the retailers were selected for phone-verification; research staff called these stores by phone to confirm they were in business and did in fact sell tobacco. Through this process, we found that over 96% of the stores on our list were indeed selling tobacco; stores verified as being out of business or not selling tobacco were removed from the list.

Gathering Hookah and E-Cigarette Retailers

Beyond licensed cigarette retailers, the state of Ohio does not have a formalized method for tracking other types of tobacco retailers—in particular, hookah cafés and vape shops. We therefore collected this information based on methods described by Kates et al.²⁷ A database of Ohio-based hookah and e-cigarette retailers was compiled from December 2017 to April 2018 using six Internet directories: Yelp, E-Cigarette-Store-Reviews.com, Hookah-Hookah, the Yellow Pages, Better Business Bureau, and Hoover directories. Search terms such as “hookah,” “hookah bar,” “hookah lounge,” “e-cigarette,” “vape,” and “vape shop” were used. Following these steps, we had an initial list of 599 vape/hookah retailers.

Duplicate retailers (n=145) were removed through comparison to the completed cigarette retailer list. All remaining hookah and e-cigarette retailers were called by phone to confirm they were still in business and did in fact sell hookah and/or e-cigarette products (73% of those contacted met this criteria). All establishments that either were no longer in business or did not sell hookah and/or e-cigarette products were removed from the list.

Geocoding Retailers

Our final list of tobacco retailers in Ohio comprised 11,392 locations (11,065 cigarette licenses and 327 vape/hookah). Code was written in the R software package²⁸ that used the ggmap R library (<https://github.com/dkahle/ggmap>) to convert batches of retailer street address into latitude-longitude coordinates. In instances where the code could not locate a retailer, individual addresses were converted to latitude-longitude coordinates using <http://www.latlong.net>. We then wrote a R program to calculate the number of tobacco retailers in each census tract.

Demographic Measures

We obtained census tract-level information about race/ethnicity, poverty, age, and population size from the 2016 American Community Survey 5-year estimates. All cut-offs distinguishing “high” and “low” groups were selected a priori. Because the state, overall, is approximately 79% non-Hispanic White, we selected a somewhat low value (15%) to be sensitive to tracts where racial/ethnic minorities are concentrated. Thus, tracts were coded as having a high prevalence of African Americans [Hispanics, Asians] if 15% or more of the population was African American [Hispanic, Asian]; all other tracts were coded as having a low prevalence of African Americans [Hispanics, Asians]. Although the prevalence of Asians is low in Ohio, a different cutoff was not used because we wanted to be consistent across racial/ethnic groups in what was considered a “high” prevalence (in other words, we wanted an absolute, rather than relative, level to indicate “high”). Age is more equally distributed in Ohio, allowing a stricter criterion for classification as having a high youth population. Thus, tracts were coded as having a high prevalence of young people if 25% or more of the population was under age 18; all other tracts were coded as having a low prevalence of young people. Finally, tracts were coded as having a high prevalence of poverty if more than 15.4% of the population was below the poverty level (15.4% is the state average for Ohio); all other tracts were coded as having a low prevalence of poverty. For exploratory purposes, models were run using different cutoffs for the demographic variables; findings indicated the same patterns of effects (available from the authors upon request).

To determine whether a neighborhood was urban, rural, or suburban, we used the county-level classifications applied by the Ohio Family Health Survey (i.e., the Ohio Medicaid Assessment Survey).²⁹ This system classifies all 88 counties in Ohio as either Metropolitan (urban), Suburban, Rural Non-Appalachian, or Rural Appalachian. For the purpose of this project, the two rural designations were combined.

Statistical Analysis

To guard against fitting statistical models to census tracts with very low populations, we removed 14 tracts with a population of less than 500 people. This left 2,937 tracts for analysis, after the removal of one further tract that was missing covariate information (poverty). These exclusions resulted in the loss of 3 tobacco retailers, leaving us with 11,389 retailers for analyses. TIGER shape files for the counties and census tracts for the State of Ohio came from the US Census Bureau (<https://www.census.gov/cgi-bin/geo/shapefiles/index.php>). Map creation, GIS, and statistical analyses were carried out in the R software package using the mapproj, MASS, mvtnorm, rgeos, sp, and SPAM R libraries.³⁰⁻³⁴

We began our analyses with descriptive statistics and figures to explore retailer density and our demographic variables. We calculated tobacco retailer density as the number of retailers per

1,000 people in each of the 2,937 census tracts. The density variable was then log-transformed (we added a value of 0.1 to guard against taking the log of zero for the 258 tracts that were found to have no retailers). Finally, we created figures of the variability in log retailer density for both Ohio overall and—for illustrative purposes—one urban and one rural (Appalachian) subset of the state.

Model Selection for Spatial Analyses

We fit various Poisson and negative binomial models to formally associate tobacco retailer density with demographic variables. We considered models that included up to three level interactions between the demographic covariates (higher order interaction introduced model instability induced by small counts in cross-tabulations of covariate factor levels). The negative binomial model³⁵ is a statistical model that accounts for overdispersion in count data (extra-Poisson variability arising from unexplained covariates or clustering effects). While these models account for possible independent random effects over census tracts, they do not account for possible residual spatial effects between the different spatial regions. Thus, we adapted a generalized estimated equation (GEE) approach (e.g., Gotway and Stroup³⁶) to correct the estimated standard errors for possible spatial random effects—details are given in the Supplementary Material that accompany this article. Starting with exploratory data analyses, we used analysis of deviance tables and the Akaike information criterion (AIC) to select between different statistical models. We diagnosed the fit of our models using deviance residual plots and tested for residual spatial dependence among the census tracts using Moran's I test statistic (e.g., Waller and Gotway³⁷). For all spatial analyses, we specified a spatial neighborhood structure to relate the different tracts. We defined the so-called neighbors of each census tract to be all the tracts that shared a border with that tract. The number of neighbors for each tract varied from 1 to 27, with a median number of 6.

Comparing AIC values and residual plots, we selected a negative binomial model that includes a high prevalence of African American, Hispanics, and Asians as main effects, as well as a three-way interaction between the high prevalence of population under age 18, high prevalence of poverty, and the urban, suburban, and rural factor variables. This model had an AIC value of 13,584, which was much smaller than the corresponding AIC value for the Poisson model of 14,450. This indicated that we preferred the negative binomial model, which allows for overdispersion in the retailer counts by census tract. Further exploration of the residuals from the negative binomial model indicated significant, but weak, spatial dependence (Moran's I statistic = 0.026, with a p-value of 0.012). To summarize the effect of the covariates upon the retailer density in the negative binomial model, we calculated adjusted rate ratios.

RESULTS

Descriptive and Exploratory Results

Across census tracts in Ohio, the median retailer density per thousand people was 0.91 and ranged from 0 to 23.99. The left panels of Figure 1 illustrate the spatial distribution of log retailer density for all of tracts in Ohio (top left panel), as well as two subsets of Ohio: Franklin county (middle left panel) and the Southeast counties of Athens, Hocking, Meigs, Noble, Perry, and Washington (bottom left panel). Whereas Franklin county is generally urban, these Southeast counties are designated Appalachian and generally rural. The maps showed substantial spatial variability in the retailer density over Ohio, with a log retailer rate ranging from -2.30 to 3.18). For example, the city of Columbus, located in Franklin county, had a retailer density that appeared to be higher in the east of the city as compared to the west; this corresponds with the distribution of racial minorities and low-income individuals in the city, as these populations are also more heavily concentrated in the east.³⁸ The retailer density in south-

east Ohio also tended to be higher on average than in Franklin county (the median observed retailer density per thousand people was 1.01 in southeast Ohio, versus 0.79 in Franklin county).

Figure 1. Observed and estimated log retailer rates

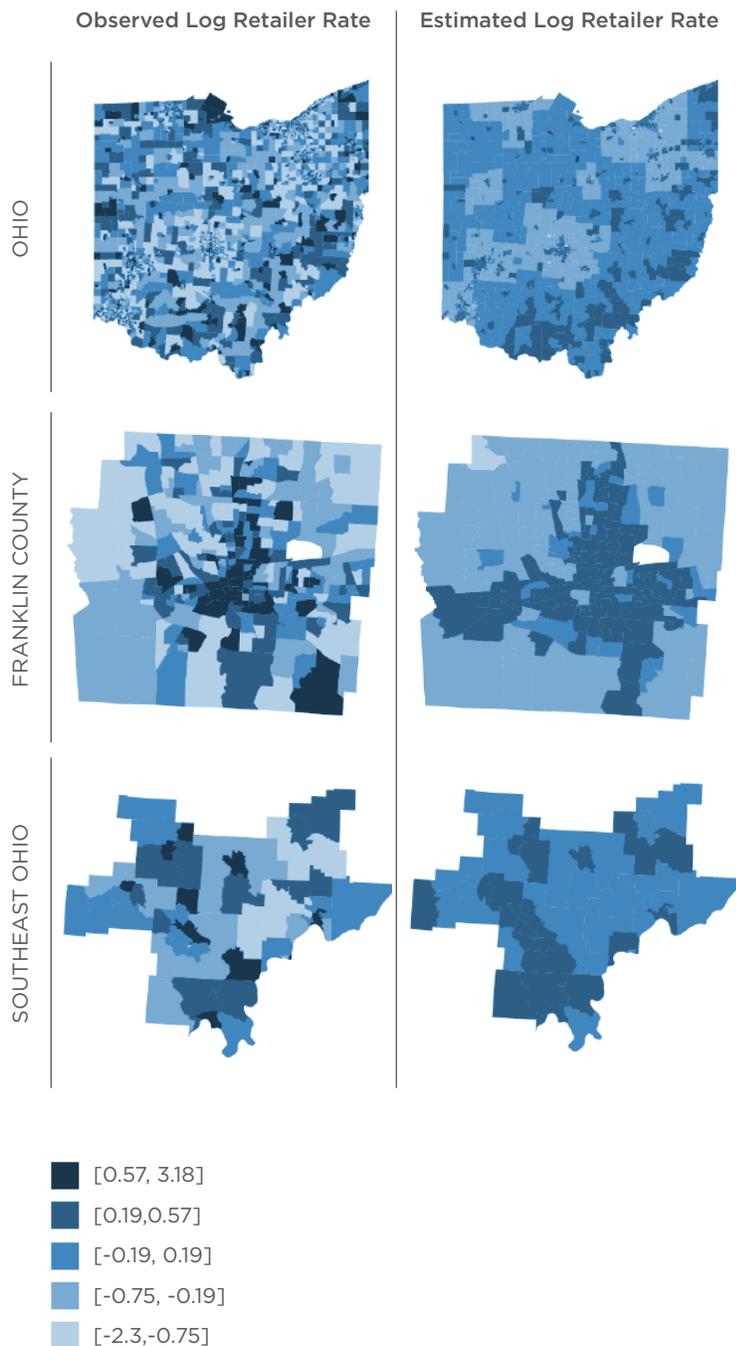


Figure 1. Left panels: Maps of the log tobacco retailers per thousand people in each census tract for all of Ohio (top row), Franklin county (middle row), and Southeast Ohio (bottom row; Athens, Hocking, Meigs, Noble, Perry, and Washington counties). The five levels of shading are defined by the quintiles of this log retailer distribution. Darker shading indicates a higher retailer density. Census tracts shaded in white were omitted from the analysis due to low population counts. Right panels: Maps of the expected log retailers per thousand people in each census tract as estimated from the negative binomial model.

Table 1 presents the demographic characteristics of Ohio's census tracts. African Americans were the most prevalent minority in the state, with 28% of the tracts classified as having a high prevalence of African Americans. Nearly half (46%) of tracts were classified as high poverty. Approximately 27% of tracts were within rural counties, 15% were within suburban counties, and 59% were within urban counties.

Characteristic	Prevalence (% of Ohio Census Tracts)	Median Retailer Density (per 1000 people)
African American High Prevalence ^a	28.0	1.08
Low Prevalence	72.0	0.84
Hispanic High Prevalence ^b	4.5	1.44
Low Prevalence	95.5	0.88
Asian High Prevalence ^c	1.3	0.68
Low Prevalence	98.7	0.91
Population under age 18 High Prevalence ^d	31.3	0.88
Low Prevalence	68.7	0.93
Poverty High Prevalence ^e	46.4	1.19
Low Prevalence	53.6	0.70
Neighborhood Type ^f Urban	59.0	0.91
Suburban	14.6	0.72
Rural	26.5	1.03

^aTracts where 15% or more of the population is African American.

^bTracts where 15% or more of the population is Hispanic.

^cTracts where 15% or more of the population is Asian.

^dTracts where 25% or more of the population is under age 18.

^eTracts where more than 15.4% of the population is below the poverty level (15.4% is the state average for Ohio).

^fClassification of urban, rural, and suburban is based on the county-level classifications applied by the 2008 Ohio Family Health Survey (i.e., the Ohio Medicaid Assessment Survey).²⁶

Figure 2 relates the log retailer density to the demographic variables. For race/ethnicity, retailer density tended to be higher in tracts with a higher prevalence of African Americans and Hispanics (there was no effect for Asian; see Table 1). There tended to be more retailers in tracts with a higher prevalence of poverty and a suggestion that tracts with a higher prevalence of people under 18 years had a lower density. In terms of urban/rural characteristics, there were more retailers in rural tracts, as compared to suburban and urban tracts. Other figures not presented here suggested the possibility of high-level interactions between the retailer density and the demographic variables, which we investigated in our statistical models.

Spatial Analysis Results

The right panels of Figure 1 display the log retailer rates estimated from the negative binomial generalized linear model, over the census tracts of Ohio overall, as well as Franklin county and Southeast Ohio. As anticipated, the expected log rates in the right panels were smoother than the observed log rates shown in the left panels. These estimated rates also confirmed that there was higher retailer density in southeast Ohio, as compared to Franklin county (we estimated a median number of 1.5 retailers per thousand people in the southeast as compared to a median number of 1.2 in Franklin county). Across Ohio overall, there was a high density of retailers in the south and east. In metropolitan areas, there tended to be both areas of higher and lower retailer densities, associated with the varying demographics by tract.

Figure 2. Boxplots of the observed log rate of tobacco retailers in Ohio, by demographic characteristics.

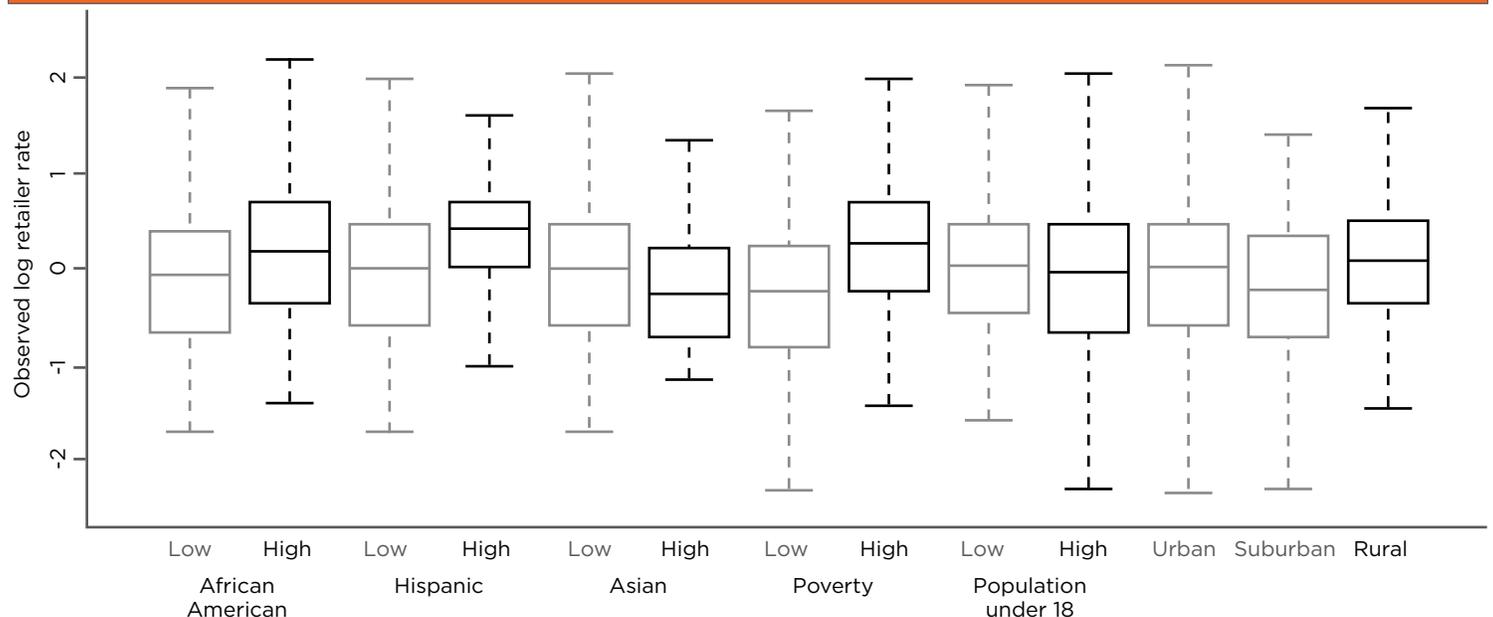


Figure 3 summarizes the adjusted rate ratios of the retailer density for different combinations of demographic variables. The left panel summarizes the race/ethnicity variables. As the race/ethnic variables appeared in the model as main effects, we could interpret them independently of the other variables. Our model indicated significantly more retailers in tracts with a high (vs. low) prevalence of African Americans (1.1 times as many; $z=2.37$, $p=0.018$) and Hispanics (1.2 times as many; $z=2.23$, $p=0.026$); there was no significant effect for tracts with a high (vs. low) prevalence of Asians ($z=-0.64$, $p=0.525$). The right panel of Figure 3 summarizes the three-way interaction in the model, focusing on the effect of poverty (higher versus lower prevalence), for different urban, suburban and rural tracts, with a lower prevalence of people under age 18 (in gray) and a higher prevalence of people under 18 (in black). Over the six combinations of levels of the variables, the rate of tobacco retailers was significantly higher in high poverty tracts versus low poverty tracts—our model estimated that the rate ratio varied between 1.4 to 1.9 as many retailers (across all six combinations of levels, all z statistics lie between 2.70 to 9.76, with p -values between <0.001 and 0.007). In populations with less people aged under 18, the effect of poverty was more pronounced, as compared to populations with more people under 18. In tracts with less people aged under 18, the effect of poverty was no different for urban and suburban tracts, but the effect of poverty may be higher for rural counties. For tracts with a higher prevalence of people under 18, there was no significant difference in the effect of poverty between the urban, suburban, and rural areas.

DISCUSSION

The purpose of this study was to estimate disparities in tobacco retailer density for the entire state of Ohio. Findings indicated that, in support of our first hypothesis, per capita density was greater in high-poverty (vs. low-poverty) census tracts. The

effect of poverty also interacted with age: high poverty was more strongly associated with high retailer density among tracts with a low youth population. In support of our second hypothesis, we found that per capita density was greater in census tracts with a high prevalence of African Americans, and in census tracts with a high prevalence of Hispanics. There was no significant effect for tracts with a high prevalence of Asians; this null effect may have been due to the low number of tracts in Ohio with a high prevalence of Asians. Our third hypothesis was not supported, as we found that per capita density was generally greater in rural census tracts, although the effect was modified by a three-way interaction: density was particularly high for rural census tracts that also had both a high prevalence of poverty and a low youth population.

Overall, our findings replicate previous work from other parts of the country by demonstrating racial/ethnic and poverty-based disparities in tobacco retailer density. These findings likewise support the identification of African Americans, Hispanics, rural populations, and low-income individuals as vulnerable populations—i.e., populations with social characteristics that put them at risk for exposure to other risks.³⁹ Our finding that rurality was associated with greater density was novel. As very few studies have investigated the relation between rurality and tobacco retailer density, researchers should attempt to replicate our finding in other areas to determine its generalizability. Our findings also extend previous work by presenting disparities at the state level: in particular, a state that varies widely in its demographic and geographic makeup. Our work also extends examinations beyond conventional retailers (e.g., convenience stores, grocery stores) to include vape shops and hookah cafés. Finally, our study improves on previous methodology by incorporating spatial statistical methods to account for spatial dependence in the data. Such methodology improves upon approaches that assume normal distributions and independent data points. Our analyses indicated that fitting a negative binomial model, while accounting for the

Figure 3.

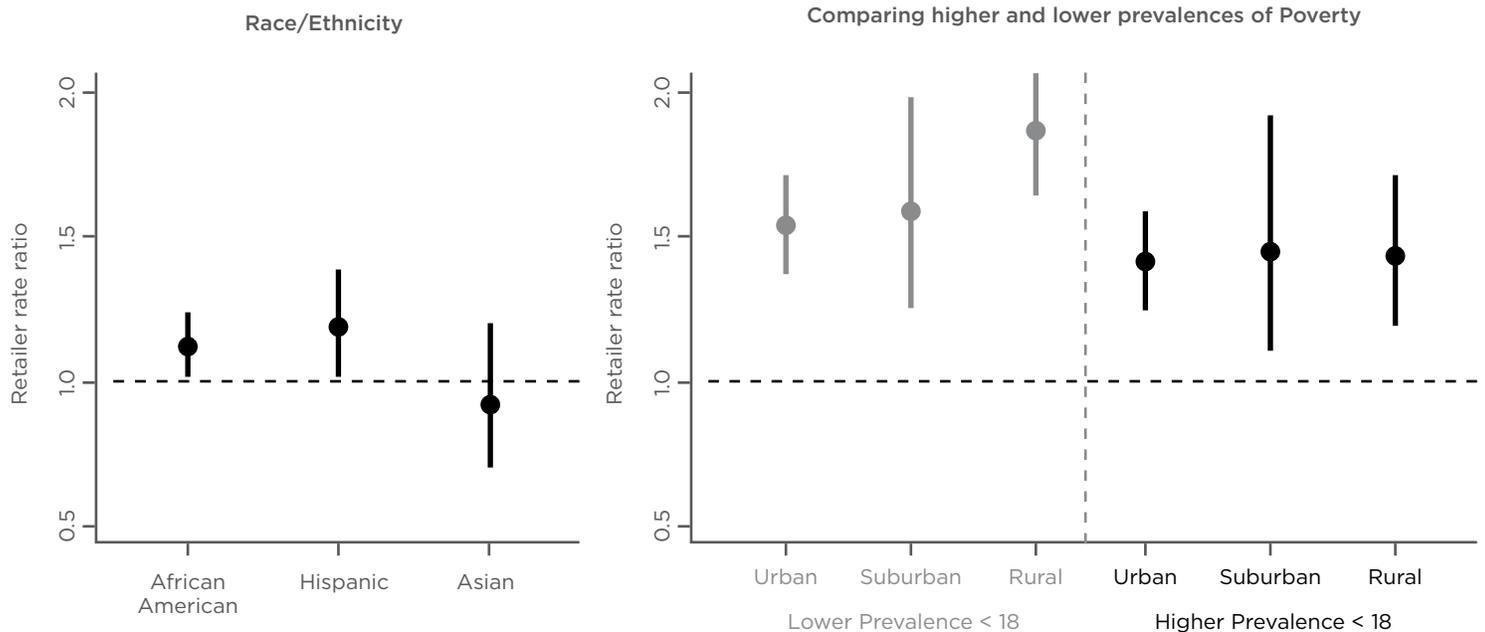


Figure 3. Summaries of the negative binomial models fit to the tobacco retailer counts in Ohio, adjusted for residual spatial dependence. The circles in the left panel show the estimated adjusted retailer rate ratios for different prevalence of race/ethnicity (comparing higher versus lower prevalence for each race/ethnicity). The circles in the right panel indicate the estimated retailer rate ratios comparing tracts with higher and lower prevalence of poverty for urban, suburban and rural tracts, as the prevalence of people aged under 18 in the population is varied (lower prevalence of under 18s in gray; higher prevalence in black). In each panel, the vertical lines denote 95% confidence intervals for each rate ratio.

residual spatial dependence, was able to account for the spatial dependence in the data, and we recommend that investigators consider this in the future.

Although Ohio's licensing system provided us with a seemingly comprehensive list of cigarette retailers in Ohio, it is possible that some cigarette retailers were unlicensed or did not have an active cigarette license at the time of data collection. It is also possible that some hookah and e-cigarette retailers may not have been detected by the online searches we conducted. Another limitation to this study is that geocoding software can occasionally produce errors, which may cause the geocoded address to not correspond exactly with the actual store location. All these limitations likely introduced some random error (rather than biased, systematic differences among communities), possibly resulting in minor perturbations in our effect sizes.

PUBLIC HEALTH IMPLICATIONS

This study found disparities in how tobacco retailers are distributed in Ohio, such that retailer density was associated with a neighborhood's racial/ethnic composition, poverty level, age distribution, and urban/rural status. Given the size and diversity of the geographical area covered in our analyses, we expect these findings to be generalizable to other parts of the country—although outcomes may differ somewhat for areas with a higher prevalence of Asian or Hispanic populations. Results from this study have concerning implications for public health, as a strong body of literature suggests that greater retailer density has a pernicious impact on local behaviors—both increasing the likelihood of youth initiation^{17,18} and decreasing the likelihood of adult cessation.²⁰ Our observations of Ohio's disparities in tobacco retailer density are thus likely contributors to the state's disparities in tobacco-related disease.

Ultimately, our findings contribute to a strong body of literature indicating a need for tobacco control policies that will target the density and impact of tobacco retailers in communities—and thereby improve equity and reduce health disparities. Such approaches may include “content-neutral” external advertising regulations; such regulations are more likely than other advertising restrictions to withstand free-speech challenges, particularly if they are enacted for aesthetic or public safety reasons. Another promising tobacco-control approach is modifying the state's current tobacco licensing laws to set stipulations on the number or density of retailers. Such strategies have been successfully implemented within several communities, such as San Francisco, New Orleans, and over 80 cities and towns in Massachusetts. Similar approaches should be considered at the state and local level in Ohio, and likewise evaluated for their impact on correcting disparities.

ACKNOWLEDGEMENTS

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RESEARCH ARTICLE

Effectiveness of a Pharmacist-Directed Tdap Immunization Program for a University Campus

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ABSTRACT

Background/Objectives: Despite a slight increase in Tdap immunization rates, the total numbers are still low among adults. The purpose of this study is to determine the impact of a pharmacist-directed immunization program. The primary objective was to assess the increase in vaccination rates among the subjects indicated to receive the Tdap vaccine. The secondary objective was to assess changes in pre and post vaccine knowledge scores.

Methods: Employees enrolled in the pharmacist-directed employee wellness clinic on a university campus in Ohio were screened for Tdap vaccination at the annual employee health fair during Fall of 2016. Results were cross-referenced with the state vaccination database. Subjects were recruited via email to an educational program. Indicated patients were asked to schedule an appointment with a pharmacist. Assessment data on the educational program was collected before the presentation and after the appointment when the vaccine was administered. The efficacy endpoint for the primary objective was a 20% increase in baseline vaccination rates.

Results: Of the 198 subjects recruited, a total of 54 received Tdap vaccination. The baseline vaccination rate of the study population was 37.4% and increased by 27.2% after the intervention to a total vaccination rate of 64.6% ($p < 0.001$). Six knowledge assessments were utilized for the secondary objective; however, these results did not show significance.

Conclusions: A pharmacist-directed Tdap immunization program is effective at increasing vaccination rates. Even though the change in education assessment data proved more observational, the education provided will empower subjects to make informed healthcare decisions.

Key Words: Pharmacists, vaccination, diphtheria-tetanus-acellular pertussis vaccines, population health

INTRODUCTION

Vaccinations are a cost-effective primary prevention service that help protect both adults and children against infectious diseases such as influenza, pneumonia, and polio. According to the Office of Disease Prevention and Health Promotion (ODPHP),¹ for each birth cohort immunized with the routine vaccination schedule, society saves 33,000 lives and saves upwards of \$9.9 billion on direct health care costs. Despite progress in immunization rates, 42,000 adults and 300 children die on average each year in the United States from a vaccine-preventable disease.

Two of the goals from Healthy People 2020² include increasing Tdap immunization rates and reducing the cases of pertussis among children less than 1 year of age and adolescents aged 11-18. Between the years of 2009 and 2013, there were 3,869 reported cases of pertussis in children under 1 year of age and 6,701 cases in adolescents aged 11-18 years.² These outbreaks could have been prevented with Tdap vaccination. It is anticipated that vaccinating adults would prevent transmission of pertussis to adolescents and young infants at highest risk for pertussis morbidity and mortality. Providing indirect protection through Tdap vaccination in adults creates herd immunity around at-risk individuals. Because of this, the Advisory Committee on Immunization Practices (ACIP)³ recommends that adults aged 19-64 years old receive a one-time dose of Tdap that would replace the usual decennial tetanus booster (Td). Among adults who are indicated by the ACIP to receive Tdap, only 20.1% actually receive it.³ Moreover, among the respondents that reported receiving a tetanus vaccination, 51.3% reported they were not informed of which vaccination they had received. Patient education plays an enormous role in identifying patients who are indicated to receive the Tdap vaccine.

There are multiple avenues available to increase vaccination rates and utilizing pharmacists has often been effective.⁴ One example of this was outlined in a study published in 2014 by Mills et al.⁵ They looked to increase Tdap vaccination rates in neonates by working with the birth families. During the study period, pharmacists and other healthcare professionals recommended the vaccine to close contacts of neonates. Pharmacists then held specific clinic hours dedicated to vaccinating these contacts. This method increased vaccination rates from 1.3 Tdap vaccinations per month to 85.2 vaccinations per month. The study concluded that the collaboration between health systems and pharmacists increased Tdap vaccination rates among close contacts of neonates; however, the impact was seen in a targeted population. Another study looking at Tdap immunization rates among a broader population was published in 2015 by Schultz et al.⁶ This study aimed to improve Tdap vaccination rates in family practice offices, but did not utilize a pharmacist to achieve this endpoint. Methods included an electronic prompt in the electronic medical record of each patient that did not have a documented Tdap vaccine. If this prompt appeared, a medical professional would recommend the vaccine. With this approach, Tdap vaccination rates increased from 33.8% to 68.0% during the first year of implementation. The study concluded that making a recommendation to patients about indicated vaccines increased vaccination rates in a medical office population. The most recent study looking at pharmacist impact on immunization rates was published by Sparkman et al. in 2017.⁷ They examined acceptance rates of vaccine recommendations made by pharmacists in a community setting and found a 35% vaccination acceptance rate for Tdap recommendations. The conclusion is that an immunization check-up performed by a pharmacist can lead to patient acceptance of recommendations of needed immunizations.

Pharmacist intervention has been shown to improve vaccination rates. Combining the approaches outlined by Schultz et al.⁵, Mills et al.⁶, and Sparkman et al.⁷ would create a program that would utilize a pharmacist to screen patients for indication, make vaccine recommendations, educate patients, and increase baseline vaccination rates across a broad population within a community. While the patient population studied had a higher baseline vaccination rate (37.4%) than the national average, there is still plenty of room to improve. There was also currently no education, other than the yearly influenza vaccine, provided to the study population prior to this intervention. The current study was designed to overcome low Tdap vaccination rates and to increase knowledge about the different tetanus vaccines in order to educate patients about the importance of their vaccine history and to know when to seek vaccination.

METHODS

Setting

The study took place in Ohio on a university campus within a pharmacist-directed, multidisciplinary, employee wellness clinic from September 2016 to April 2017. The employee wellness clinic partners with the Human Resources department at the university to provide free screenings, disease state management, and health education to employees insured through the university's health plan. As an incentive to participate in the campus wellness program, employees can accumulate points by attending health screenings, engaging in healthy activities, having lab values in range or achieving improvements in lab values, and attending educational programs. Once the employee reaches a predeter-

mined amount of points, they earn a discount on their insurance premium for the following year. This model increases participation in health activities, while providing a reward for individuals who make healthier choices.

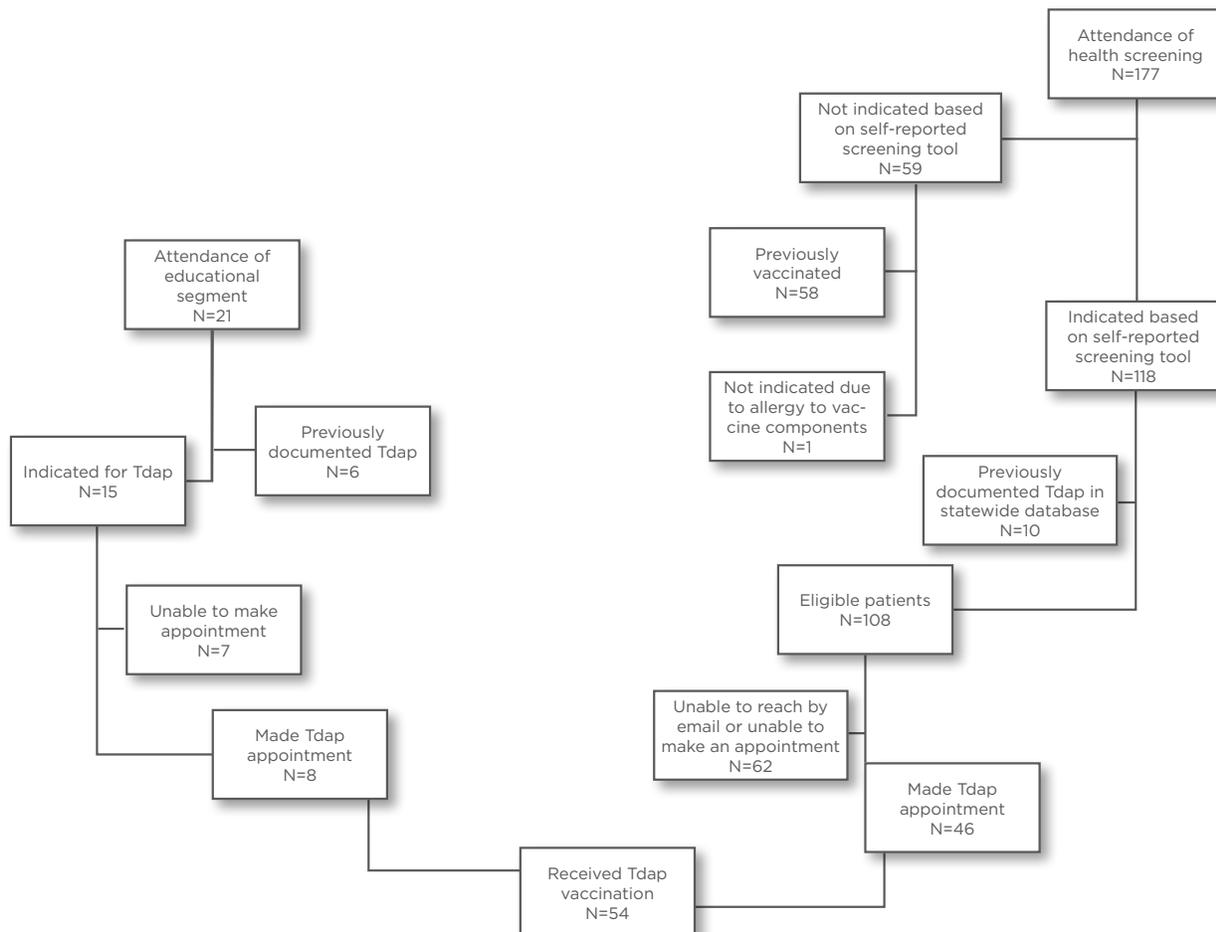
Design

This study was designed to be a prospective, observational study. Subjects were identified by a pharmacist via a health screening and an educational program. Subjects were screened for Tdap vaccination indication as defined by the ACIP and findings were cross-referenced against the state immunization database for accuracy. Subjects who had an indication for the vaccine were recommended to make an appointment with a pharmacist to receive the vaccination.

Participants

To be included in the study, patients had to be ≥ 18 years old, an employee or retiree of the university, and be indicated and willing to receive the Tdap vaccine. Each patient completed a Tdap Indication Screening Tool (TIST) assessment to determine if a Tdap vaccination was indicated. Patients were ineligible to participate if they had previously received Tdap as an adult, if they were ineligible based on ACIP recommendations, or if vaccination was contraindicated. A breakdown of patient enrollment is displayed in Figure 1. Patients that matched the inclusion criteria were identified in September 2016. Participants were notified of the opportunity by a pharmacist through a variety of routes, including a face-to-face screening and an educational presentation marketed through the wellness clinic.

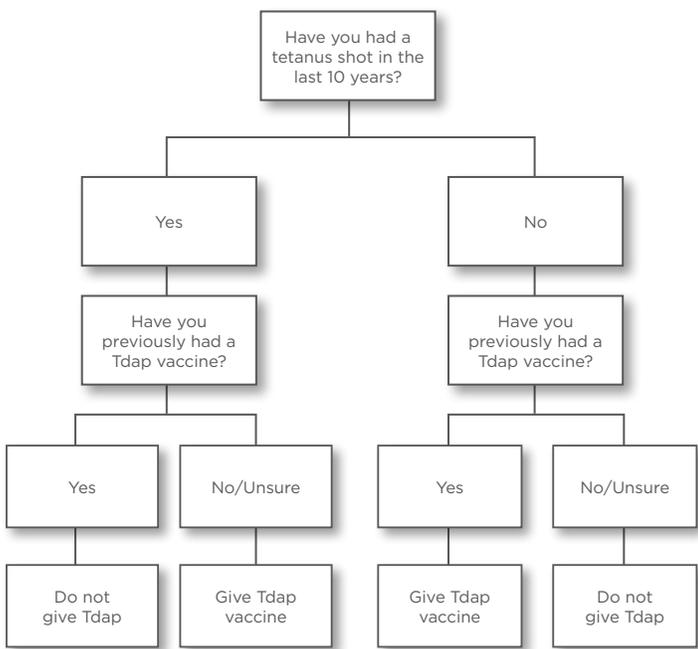
Figure 1. Breakdown of patient enrollment



Procedures

Subjects were screened for Tdap indication using a Tdap Indication Screening Tool (TIST) starting in September 2016 at a university health fair. Questions asked on the TIST were derived from the ACIP guidelines for Tdap recommendations. Based on the answers to the screening tool, an algorithm was developed to determine the need for vaccination. Figure 2 outlines the algorithm by which Tdap indication was determined. Pregnancy was not included in the algorithm due to specific timing of immunization in this population. No participants were found to be pregnant during this screening and follow-up would have occurred if found. A pharmacist was present during the screening to answer any questions. Subjects were indicated to report no previous Tdap vaccination if they were unsure of status. After all the participants were screened, all the TIST results were compared against the Ohio Statewide Immunization Information System (SIIS).⁸ A total of 177 patients were screened at the health fair. Of these, 68 were found to have previous Tdap vaccination and one was allergic to vaccine components. Initially, 58 self-reported as having previous Tdap vaccination. After cross referencing with the statewide vaccination data base, an additional 10 were identified as having a documented Tdap who were previously unsure of vaccination status. Subjects with a positive Tdap indication as determined by the ACIP guidelines were contacted via email to make an appointment to receive the vaccine.

Figure 2. Algorithm to determine Tdap indication derived from answers to self-reported screening questions



An educational program was developed and delivered by the pharmacist to employees of the university to address knowledge gaps about Tdap, the decennial Td booster, pertussis, and tetanus as previously identified by the ODPHP. A total of 21 subjects attended the educational program, where 6 were found to have previously received the Tdap vaccine. Participation was incentivized with healthy campus points and a pretest was given to subjects prior to the start of the program. There was no overlap of subjects between participants screened at the health fair and those who attended the educational program, even though participants at the health fair were invited to attend the education program.

Each Tdap clinic appointment was held at the on-campus health center and was led by a pharmacist with student pharmacists certified in immunizations available to administer the vaccine. After a safety assessment, the Tdap vaccine was administered and the patient was monitored for 10 minutes to ensure there were no adverse reactions. The posttest was administered at the time of vaccination for subjects who participated in the educational program. Both the pre-test and posttest consisted of the same four items pertaining to information covered during the educational program. The amount of time between pre-test and posttest varied among subjects, however, a minimum of 2 weeks between the assessments was applied, to limit short-term recall. All subjects were given written record of the given vaccine and all vaccinations were uploaded into the patient profiles on the state immunization database.

Outcomes

The primary objective of this study was to assess the effectiveness of a pharmacist-directed Tdap vaccination initiative. The primary outcome variable was the change from baseline vaccination rate compared to the change in post-intervention immunization rate with Tdap. A 20% increase in baseline vaccination rate within the study population was targeted based on evidence of change from baseline in previous literature. Studies of comparable target populations found increases between 30-35% within a year of implementation. With a shorter timeframe to make an impact, a goal of 20% was derived.^{6,7} The secondary outcome assessed the change in patient knowledge of pertussis and the Tdap vaccine through education delivered by a pharmacist during the immunization initiative. It was hypothesized that utilizing an ambulatory care pharmacist to educate and screen patients and administer vaccines would increase vaccination rates and improve patient knowledge.

Statistical Analysis

Data was analyzed using descriptive and inferential statistics. SPSS version 22 (IBM, New York) was utilized for statistical analysis. A McNemar’s test was used to analyze the difference between those eligible for the vaccine at baseline and those who then received the vaccine. The mean percentage change in Tdap immunizations from baseline compared to the mean percentage in post-intervention group was provided as descriptive data. Fisher’s Exact Test was utilized to compare the pre and post educational scores. Alpha was set at 0.05 for the primary outcome variable.

Institutional Review Board Approval

The university’s Institutional Review Board approved the study. Patients were required to sign an informed consent form prior to inclusion into the study.

RESULTS

After administering the TIST and comparing those results to Ohio Impact SIIS, a total of 198 patients were included in the study, which revealed a baseline vaccination rate of 37.4% (74/198). The majority of subjects were female (70%) and age ranged from 23-83 years old with an average age of 50. A total of 177 subjects were screened at the health fair and 108 were found to be indicated for the Tdap vaccination. Of the 21 subjects participating in the educational segment, 15 were identified as having an indication for Tdap. Of the 108 subjects that were eligible for vaccination from the health fair, 46 went on to make an appointment and receive the vaccine. A total of 8 subjects of the 15 identified as eligible from the educational segment went on to make appointments and receive the vaccine. The pharmacist-directed clinic administered the Tdap vaccine to 52 of the 123 eligible subjects. Two individuals received their vaccine at their local pharmacy after recommendations encountered during the program. This led to a final vaccination rate of 64.6% (128/198), an increase of 27.2%

from baseline vaccination rate. An acceptance rate of 43.9% in vaccination recommendation was also achieved. McNemar's test of the primary outcome variable of vaccine acceptance in the eligible population was statistically significant at a p value of < 0.001.

Of the 8 assessments completed, a total of 6 assessments were available for analysis due to lack of completion of the full assessment by 2 individuals. A limited number of assessments were available due to a small sample attending the educational program and a smaller subset of attendees going on to receive the Tdap vaccine. Table 1 outlines questions asked on both pre and posttest and the respective number of correct answers. All questions improved following the educational program, except one. The trend in change on question 4, which asked the difference between the decennial Td booster and the Tdap vaccine, demonstrated improvement, although the sample size was inadequate to confirm this finding statistically.

Table 1. Questions utilized to assess patient knowledge and the number of correct responses on the pre and posttest

Question Number	Pre and Post Assessment Questions	Number of correct responses on pretest	Number of correct responses on posttest	p-value (n=6)
1	What diseases does the Tdap vaccine protect against?	3	5	0.27
2	Who needs to get the Tdap vaccine?	5	4	0.5
3	How often do you need a Td vaccine?	3	5	0.27
4	What is the difference between the Tdap and the Td?	1	5	0.04

DISCUSSION

Prior to this study, there was limited evidence demonstrating the benefit of a pharmacist-directed Tdap immunization program in a generalized population setting. Immunizations were offered through the health and wellness clinic prior to this study; however, the service was not routinely utilized by patients for vaccines other than the yearly influenza vaccine. This program provided evidence that a pharmacist-directed vaccination program would increase Tdap vaccination rates and could increase patient knowledge about Tdap vaccinations.

There were many strengths to this study, including the demonstration of effectiveness of a pharmacist-directed immunization program. This program provides data outside of a specialized population and provided a necessary service for improving public health. All patients that were enrolled into the program were screened for indication and verified through the statewide immunization database. This added a level of validity to the self-reported nature of the screening tool. In addition, all subjects were provided with written vaccination record and all vaccinations given were uploaded into the patient profiles on the statewide database.

This study was found to have similar efficacy as other previously published studies. The study performed by Schultz et al.⁶ found a 34.2% increase from the baseline vaccination rate in a one-year time frame. While utilizing similar methodology of making vaccination recommendations to indicated patients, this study found a 27.2% increase from the baseline vaccination rate within a shorter study duration of 7 months. This study also found higher vaccination acceptance rates than the study performed by Sparkman et al. with 43.9% of participants in this study accepting the recommendation compared to 35% seen in the previous study.⁷

This measure could also be due to the nature of the wellness clinic and how participation is incentivized through deductions in health insurance premiums.

There were some limitations in relation to this study. Even though the statewide database was utilized to ensure vaccine indication, the screening tool relied heavily on self-reported data. This presented some challenges, as several subjects were unsure when they received a Td booster or if they had ever received a Tdap. The pharmacists tried to account for this in the algorithm. If patients reported having a Tdap, but received a tetanus shot more than 10 years ago, the likelihood they actually received a Tdap vaccine as an adult is very unlikely. This is due to the fact that the Tdap vaccine was first approved in 2005 and was recommended for routine adult vaccination by the ACIP guidelines starting in 2006.⁹ It was estimated that only 5.9% of the United States population had received a Tdap vaccine in 2008¹⁰ and 17.2% in 2013.⁵ With this information, it is highly unlikely that the tetanus shot the patient received as an adult more than 10 years ago was indeed Tdap. The younger employee population did have individuals who reported no previous Tdap vaccine who indeed did receive it as adolescents. However, they were still indicated to receive the vaccine as an adult. The state database was especially helpful in this population as their records were up to date. While cross-referencing the statewide database, it was found that individuals born before the late 1980's had incomplete or no records uploaded into the database.

Power was not met for the secondary endpoint; however, with more participants in the educational program, significant changes could have been seen. This was evidenced by the fact most assessments improved, but only one question was found to be statistically significant. However, conclusions cannot be drawn from this due to the low number of assessments. Even if all participants from the educational program completed pre and post assessment data, power would still not have been met. Improvements to future studies would have multiple education programs to capture more subjects or administering the posttest online to capture all attendees regardless of vaccination status. Another limitation to the educational assessment relates to the education level of the participants. The majority of the participants were college professors that teach subjects such as chemistry, biology, and pharmaceutical sciences. While some of the participants were not faculty members, the education level of the population could be higher than a different population who would take this assessment.

PUBLIC HEALTH IMPLICATIONS

A pharmacist-directed Tdap immunization program is effective at increasing vaccination rates. With the implementation of the program, immunization rates increased by 27.2% from baseline within the study population with a statistically significant acceptance rate of Tdap vaccination in the eligible population ($p < 0.001$). With these results, more patients will be protected from the transmission of pertussis. Knowledge about tetanus, pertussis, Tdap and the decennial Td booster increased even though these results proved more observational. While not statistically significant, the increase in knowledge is successful at empowering the subjects to make informed healthcare decisions, which in turn may result in making vaccination recommendations to friends and colleagues, further increasing vaccination rates.

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APhA-ASP Operation Immunization

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RESEARCH ARTICLE

Pregnancy Expectations and Experiences among Women in Southeast Ohio: Implications for Clinical Practice

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ABSTRACT

Background/Objectives: Nearly 4 million women experience pregnancy every year in the United States. While there is research about medical outcomes related to pregnancy, especially in the context of disease, there is a dearth of research related to pregnancy expectations.

Methods: This qualitative study explored women's expectations and experiences of pregnancy in Southeast Ohio. Participants attending a clinic were recruited for individual interviews onsite at the physician's office. Interviews were audio recorded and transcribed verbatim. Codes, in the form of descriptive labels such as words or brief phrases, were developed based on entire interviews.

Results: Results indicate that women experience pregnancy on a continuum, some women enjoyed the experience, some were ambivalent, while others did not enjoy the experience. Furthermore, some women reported that their expectations for pregnancy matched their experience(s), while others felt that their expectations did not match their experience. Some women also felt "judged" by other women and even health care providers if they did not "love" the experience.

Conclusions: Women experience pregnancy in a variety of ways, therefore, it is important that health care providers be sensitive to the notion that not all women enjoy the process, but they all want the same outcome of a healthy child. While it is important for health care providers to assess the physical health of the mother and the unborn child, this study demonstrated that it is also important to assess what an expectant mother knows about pregnancy and what she expects to happen.

Key Words: Pregnancy, Appalachia, reproductive health, contraception

(doi number goes here)

INTRODUCTION

Our understanding of women's expectations and experiences of pregnancy and childbirth are increasingly salient to informing and improving maternity policy, practice, education, and research.¹ The Centers for Disease Control and Prevention confirms that there were 3.9 million births in 2016 in the United States.² There has been extensive research about women's expectations and experiences around the world.^{1,3,4,5,6} While women tend to report that they are satisfied with the care they receive during pregnancy and childbirth,⁷ there is a tendency to focus on the medical outcomes related to pregnancy, especially in the context of health and disease conditions.¹

Pregnancy expectations research has been conducted related to childbirth among pregnant women^{1,8,9} and fathers-to-be.¹⁰ Researchers have also explored parenthood among expectant parents,¹¹ the perfect baby among expectant mothers,¹² and working while pregnant.¹³ Additionally, studies have investigated the experiences of Mexican-American women¹⁴ and diabetic women¹⁵ and provided comparisons based on race and ethnicity.¹ Furthermore, Miller et al.¹⁶ explored postpartum social support among pregnant women. The collective body of research suggests that when women and/or parents have positive expectations, their outcomes are perceived as more positive than women/parents who have negative expectations.⁹

The current study focused on Southeast Ohio, part of the Appalachian region of the United States. Appalachia is a vast region

covering over 205,000 square miles (530,000 kilometers) and is composed of mountainous terrain.¹⁷ It is often ranked as one of the poorest regions in the country due to its low per capita income, which is among the lowest in the country and this perhaps explains the vast disparities in availability and access to adequate health care services.¹⁸ While there is research about medical outcomes related to pregnancy, especially in the context of disease, there is a dearth of research related to pregnancy expectations and experiences in this region. Research on pregnancy in Appalachia is focused on risk factors for negative pregnancy outcome such as smoking,¹⁹ intimate partner violence^{20,21} as well as the impact of rural residence on birth outcomes.²² Given that women experience pregnancy in a variety of ways, it is important to further investigate how women understand their pregnancy expectations vis-à-vis their lived experiences in Southeast Ohio, a region hampered by insurmountable health disparities. To that end, the purpose of the current study was to explore women's expectations and experiences of pregnancy in Southeast Ohio. Specifically, the study aimed to (1) better understand the expectations and needs of pregnant women in Southeastern Ohio and (2) examine the women's information-seeking behaviors, feelings regarding the support they received from doctors, family, friends, and others during pregnancy. The results of the current study will be used to develop hypotheses that can be tested in a larger quantitative study. Findings from the larger study will advocate for integration of services within existing maternal and social services as well as inform clinical communication trainings to enhance health care providers' sensitization to the expectations and experiences of expectant mothers.

METHODS

Setting, Design and Participants

Participants were recruited from a public OB/GYN clinic as well as a social media social support group for mothers within the area. The study had projected interviewing up to 40 participants, but 14 participants were deemed sufficient after reaching data saturation.¹⁹ At the clinic, paper fliers were posted on poster boards and distributed to female patients attending the clinic, while electronic fliers were posted in the social media of support groups. All fliers contained the research team's contact information and participants were instructed to call/email to express interest. A snowball sampling method was also applied, whereby participants were asked to suggest other potential participants.

Procedures

After receiving consent, interviews were conducted for one hour and participants received a \$15 retail store gift card for their participation. Participants were interviewed by three members of the research team. The semi-structured nature of the interview enabled the interview questions to reflect and be informed by the participants' experience, perceptions, and concerns. All participants consented to being audio recorded. All audio-recorded tapes were transcribed verbatim. Transcripts were compared with recorded interviews to ensure accuracy and the names of the women, family members, and caregivers were replaced with pseudonyms.

Measures/outcomes

A semi-structured interview guide was used to conduct interviews (available upon request). The semi-structured guide included questions about pregnancy onset (e.g. describe your reaction to finding out you were pregnant?, who did you tell first?, how and when did you chose to tell others?); expectations and actions taken (e.g. what did you expect to happen during pregnancy?, did your expectations match your reality?); family and relationships (e.g. were there changes in your relationship with others throughout your pregnancy?, do you feel your needs were met throughout your pregnancy?); support networks (e.g. what kind of support did you expect to receive while pregnant?, did you receive the kind of support you expected?); as well as demographic information (e.g. age, race, marital status, employment and insurance coverage).

Statistical Analysis

Thematic analysis of the data was undertaken, in keeping with the steps outlined by Green et al.;⁴ namely, immersion in the data, coding, creating categories and identifying themes. Immersion in the data initially occurred in the interview phase, which was conducted by three of the authors and continued throughout the analysis process with repeated close readings of the transcripts, listening to the recordings, and discussion among the interviewers. Codes, in the form of descriptive labels such as words or brief phrases, were developed based on entire interviews. This was done by the three interviewers. A second round of coding was conducted through a cyclical process including the use of markers to color code each transcript based on the words and phrases identified in the initial coding. Open coding was then employed to create a list of categories, which was followed by discussion and comparison among the research team to determine the final list of categories. Finally, all interview transcripts were coded by two of the authors to identify themes based on relationships between the lists of categories.

Institutional Review Board Approval

Approval to conduct the study was provided by the Ohio University Institutional Review Board.

RESULTS

Fourteen (n=14) semi-structured interviews were conducted among women who were either pregnant or had given birth less than one year from the time of data collection. The mean age was 29 years and majority were non-Hispanic White (71.4%). Of those interviewed, 100% were partnered, 78.6% were employed, 57.1% had a college education and 92.8% had health insurance. Only 35.7% were currently pregnant and 64.2% reported that their pregnancy was planned. The median monthly income reported was \$2303.57 (Table 1). Of the women interviewed, two had two previous children, two had one previous child, and ten of the women were discussing the pregnancy of their first child.

Table 1. Characteristics of women in the study (n=14)

Characteristic	Mean (SD) or %
Mean Age (range 21-39)	29.21 (SD = 5.7)
Currently pregnant	35.7%
Planned pregnancy	64.2%
Non-Hispanic White	71.4%
Married or partnered	100.0%
Insured	92.8%
Employed	78.6%
College graduate	57.1%
Median monthly income	\$2303.57

Emerging Categories

Four major categories emerged from the analyzed interviews: pregnancy expectations, learned pregnancy expectations, expectations versus reality, and pregnancy experience. Within two of the four major categories, some sub-categories also emerged (see Figure 1).

Figure 1: Pregnancy Expectations and Experiences



Pregnancy expectations

Participants acknowledged that they had preconceived expectations throughout their pregnancy. These expectations were associated with physical (bodily changes), emotional, and financial expectations.

Physical expectations: Participants highlighted that the most common expected bodily changes were nausea, weight gain and fatigue.

For those participants who experienced nausea, they had expected the major change to be associated with physical change such as increase in breast size:

"The nausea. For some reason I kept thinking, man I'm going to get these giant boobs...oh gosh, I'm ready for these giant boobs. I'm going to be waddling I guess." (P1)

However, some did expect significant physical changes like weight gain, but were not aware of the extent to which such changes would be debilitating:

“Well I definitely expected this, the belly! I figured I would be tired, but it was more than expected, I was always so tired, like, this extreme fatigue.” (P8)

It is apparent that weight expectations were obvious, but participants did not anticipate suffering from extreme exhaustion and nausea.

Emotional expectations: In addition to physical changes, participants also reported experiencing emotional changes that enhanced the bond between the mother and unborn child:

“Emotionally, I thought I would turn into the [most] sappiest, touching my belly, holding my bump. Ah, this is so beautiful, oh my gosh! Coming home from work being all tranquil just sitting, holding my belly, singing to it.” (P7)

Other participants reported experiencing feelings of fear and anxiety. For example, one participant reported that she endured a plethora of emotions that were far beyond her expectations:

“I was really happy. I was really emotional, kind of scared, nervous, you know. I had so many emotions running through my body...I expected to be emotional and cry for no reason.” (P10)

Emotional expectations seemed to range from happiness to fear to anxiety and much more given the hormonal changes they were experiencing during their pregnancy.

Financial expectations: While some participants reported physical and emotional roller-coasters, other participants' expectations were in relation to finances. Finances heightened their anxiety. For example, one participant reported that:

“I did have a few panic attacks, but I don't know if that was just from working the 2 jobs and my boyfriend stressing about the finances, which had me stressing out about finances.” (P1)

Mental health challenges need to be examined further to ensure optimum health outcomes for the mother and unborn child. Participants acknowledged that financial expectations were not only influenced by the pregnancy but also anxiety from a significant other. Financial expectations were a primary source of negative stress for most of the participants:

“I constantly thought about the fact that we would need to try and save a lot more money for baby to come, we'd have to spend money because baby was coming, we'd have to buy new clothes because of my maternity clothes.” (P7)

Financial expectations superseded both physical and emotional expectations, particularly for first time mothers. The anxiety of an additional mouth to feed signified increased anxiety.

With regard to women who had more than one child, their expectations were slightly different from first-time mothers. They acknowledged having less expectations and resulting anxiety. As reported by a participant:

“The first one I was probably anxious because it was the first child. This time I don't feel like I was too overly stressed or anxious not that I remember.” (P4)

It is evident that pregnancy expectations were heightened in the first pregnancy as opposed to subsequent pregnancies.

Learned pregnancy expectations

In addition to individual expectations, some participants revealed that they knew what to expect due to exposure to media, family/friends and health care providers.

Media: Participants highlighted the salient influence of media in enhancing expectations of pregnant women. Most women reported learning about their pregnancy expectations from electronic media: websites, blogs, and web applications. As reported by a participant, she utilized the Internet to provide her with information:

“I would read a lot online. Any time I would feel anything new, I would look it up to make sure it was normal.” (P12)

Other participants utilized their phones where they downloaded applications that helped them track physical changes. For example:

“I have an app. The 'What to Expect' app...It shows me how much weight I should have gained by this point, and my baby is supposed to be the size of a cucumber this week. Like, almost a foot long. Like, wow!” (P8)

Participants who were tech savvy were able to access information using web applications and online websites. The challenge with such access is having to sift through a lot of information that may not always be accurate.

While some participants utilized online platforms on the web, other participants knew what to expect by watching television:

“Probably just TV, I don't think I read too many books...just from the fictional books that I had. Just knowing okay, you get pregnant and then all of a sudden you have a baby. No one really talks about the in-between that I was really uncomfortable, or I was going to the bathroom a lot. You have baby and you scream really loudly for like 10 minutes and then the baby is here. Which is all I really knew because that is what is represented in media. I also joined a couple online forums and used the What to Expect App.” (P10)

Furthermore, some women formed online relationships with other mothers through Facebook groups or other networks:

“I am constantly talking to other mothers on social media. All my friends asking a million questions. Asking the doctors questions. Just a lot of word of mouth too you know. Just hearing people with their experiences.” (P4)

The use of online resources could be related to the uncertainty many women expressed regarding pregnancy. These women acknowledged that they were interested in gathering as much information as possible to assist them during their pregnancy journey.

Family and friends: In addition to media sources and online relationships, many women also relied on family members and friends to understand what to expect:

“I didn't know a lot about babies so, I can remember getting things at my baby shower and not knowing what they were or what to do with them. I had a lot of help from my mom and my grandma and of course, my mother-in-law.” (P2)

Participants acknowledged that having family members available to assist with the pregnancy, minimized anxiety that stemmed from traditional events such as baby showers. In addition, some participants knew what to expect because they had assisted their pregnant relatives.

While families were deemed very instrumental in assisting pregnant mothers who did not know what to expect, other participants acknowledged having friends who were available to provide a helping hand when the expectant mother did not know what to expect:

"I asked a lot of questions. I have a neighbor who was very helpful. Every weekend in the fall, last fall, we'd go up to Columbus and she took me to like Buy Buy Baby and Babies R Us and told me like, "you need this, you don't need this." So just was like a mentor. And I'd ask my in-laws, my mother and my mother-in-law, and they had children so many decades ago that the knowledge that they had wasn't current, they didn't remember, so like it was really nice to have someone who had just gone through it a few years ago." (P11)

The support from family and friends made a big difference and seems to have enhanced the participants' self-efficacy. Women with strong support systems tended to have more positive experiences.

Health care providers: Some participants acknowledged that they knew what to expect based on their interaction with their health care providers:

"Well my doctor, of course. I came in with a list of questions my first appointment, and I have a baby center app on my phone. If I have any questions, I just like type in the question and then I'll get answers that come up." (P9)

This participant's expectations about pregnancy were informed by her technology savvy skills and face-to-face time with her doctor. Her ability to utilize the web application on her phone and her proactive nature of asking questions enhanced her knowledge of what to expect.

Women who reported learning about pregnancy expectations from their doctors typically had very good experiences, based on a foundation on trust:

"I just started going with what the doctor had told me to do. By that time, I had a pretty good relationship with the doctor I had been seeing. So, I knew I could trust her with any questions that I had and try to see her as much as possible." (P6)

"She was very excited. She said she actually went down to the lab because she wanted to be the one to give me the results herself. She knew how much we had been wanting kids. So she waited for them to run the test and then ran the print up to us instead of waiting. So that was sweet." (P12)

Patient-doctor relationship for expectant mothers emerged as important in establishing trust that enhanced the probability of patient satisfaction with her pregnancy expectations as well as services rendered.

However, while some participants were happy with their health care providers' ability to address their pregnancy expectations, other participants expressed some level of disappointment with their patient-doctor experiences. These negative experiences varied largely and included: not being able to have their doctor present for delivery, feeling as though a doctor was indifferent to their concerns, not receiving desired or needed information from their doctor, and not being included in their health care decision making. The women who experienced these sentiments did not typically reference a previous positive relationship with their care providers:

"That doctor to be the one that I'm dealing with and seeing because she knows my chart, she knows my personality, she knows everything and here I am explaining everything to a new person every eight hour when they change shifts. So, I'm like ah, this isn't what I wanted, yeah. If you would've explained this to me beforehand, might've gone with the midwife who like hands out her cell phone and you just call her, and she is there the whole time. I liked my doctor and she did awesome throughout the pregnancy but for the actual birth I would have liked to have her there, the person I had been seeing, there." (P10)

Doctor-patient relationship for expectant mothers was deemed important because of the personal connection and trust placed on the doctor by the patient. This was important in ensuring patient satisfaction.

Expectations vs. Reality

Less than half of the participants reported that their expectations matched their reality. Most women reported a mismatch between their expectations and experiences of physical changes and emotional changes. Women were commonly shocked by the intensity of emotional changes as seen here:

"I think the overwhelming amount of emotions was the biggest thing for me. I was thrilled to be pregnant. I thought that was going to be it...I had done my research. But I wasn't prepared for the feeling of fear or anxiety." (P4)

While most women expected negative symptoms, many were surprised by what symptoms they had, or the intensity of their symptoms:

"I was a lot more uncomfortable than my expectation was. My expectation was, oh this glorious journey through pregnancy and growing this little human. It's not going to hurt or anything at all. I had PDS at 13 weeks...it hurt to walk, it hurt to sit, it hurt to pretty much be." (P10)

"I figured I would be sick a little and obviously uncomfortable towards the end of it. I had no idea that I would have what I felt like was the worst 10 months of my life." (P5)

Some women did, however, have compatible expectations and realities:

"I expected to nest and I really enjoy that I did. Um, I expected to have a healthy pregnancy and I think I did." (T11)

The juxtaposition between reality and expectations reveals the unpredictability of the physical body changes during pregnancy and the emotional toll these women experienced.

Pregnancy Experience

Most of the women reported positive changes in their relationships with others. For example, the pregnancy experience helped some participants' relationship with family members to blossom:

"The biggest change I saw was that I've always been very distant with my in-laws. They were suddenly excited to see me and wanted to spend more time with me and that was something I'd never known from them before." (P12)

"One of my siblings and I had a very rocky relationship before I got pregnant. And then he had been like 'you know, you're going to be having my nephew. I really want, you know, us to work things out.' So our relationship had gotten better." (P14)

When women were asked how they felt overall about being pregnant, some loved it, some were ambivalent, and others disliked it:

"I felt fine. Everybody is like man it is horrible and I am like it is not that bad." (P9)

"It was a really wonderful time of life, very special. Loved it." (P11)

"I honestly felt miserable the whole time. I didn't have that fun, warm pregnancy glow and wasn't anything like I expected." (P5)

DISCUSSION

The current study focused on Southeastern Appalachian Ohio and explored women's expectations and experiences of pregnancy. Four major categories emerged from the analyzed interviews: pregnancy expectations, learned pregnancy expectations,

expectations versus reality, and pregnancy experience. Although there is extensive study regarding the disease state and medical outcomes of pregnancy, there is a deficit in pregnancy related research. Knowing what expectations pregnant women have, and how they come about these expectations has great potential in the clinical and community setting. Because of the small sample size, these findings are only speculative and need to be researched further.

The study revealed that women experience pregnancy in a variety of ways. Most of the women reported pregnancy expectations in the form of physical changes, but few discussed expectations related to emotional changes. Documented evidence indicates that pregnancy expectations vary on a continuum of very positive to very negative, but most women anticipate parenthood with enthusiasm and excitement.²³ In the current study, women reported shaping their expectations about pregnancy by interacting with other pregnant women, reading books, finding information on the internet and, to a lesser extent, from their physicians.

Given that women experience pregnancy in a variety of ways, it is important in pregnancy that health practitioners provide credible information or resources about what to expect to happen physically and emotionally. Many women expressed some level of disappointment with their patient-doctor experiences. These negative experiences varied largely and included: not being able to have their doctor present for delivery, feeling as though a doctor was indifferent to their concerns, not receiving desired or needed information from their doctor, and not being included in their health care decision making. The women who experienced these sentiments did not typically reference a previous positive relationship with their care providers. Documented evidence reports that positive expectations are linked with better prenatal care, decreased substance abuse, adequate nutrition, and social practices that benefit maternal and infant health.²⁴ So, health practitioners need to assess the pregnancy related expectations and educate them on what are normal symptoms to expect while pregnant. One critique that arises in relation to studies that seek to address women's expectations is the fact that it is typically based on a pre-determined list of issues, reducing researchers' ability to share the nuances of experiences and opinions.⁷ ²⁵ Additional studies will elucidate if these findings are related to doctors' patient load or training, the culture of the region, or other reasons.²⁶

The majority of women said that pregnancy had a positive effect on relationships, and some expressed that they "loved" being pregnant and others were "miserable" while pregnant. Ayers and Pickering found that women who were generally anxious in pregnancy were more likely to express negative emotions and poor support.²⁷ Women with strong support systems tended to have generally more positive experiences. Many women reported that they learned what to expect with pregnancy through conversations or observations of family and friends. These women relied on their support systems for information on what to expect in pregnancy. On the contrary, Bouchard found that individuals who displayed overly optimistic and simplistic expectations before birth, despite social support, were likely to suffer depressive symptoms and marital dissatisfaction post-partum due to mismatched expectations.²⁸ It is paramount to caution pregnant women not to be overly optimistic but also provide both prenatal and post-partum counseling to prepare parents to face reality and resulting changes.^{28,29}

This study only included women living in an Appalachian region because the study was conducted in an Appalachian County and recruitment primarily depended on referrals. Interviews were only conducted among self-selected participants which means that there are many who did not self-select who could have provided pertinent information. Thus, findings may not be generalizable across similar populations. The study was completed in one of the poorest counties in the State of Ohio where the median

income is \$37,191 annually and 29% of the population live in poverty, compared to \$52,652 and 12% for the rest of the state.³⁰ Comparatively, our study median income was about \$28,000, which would suggest that our study included a diverse range of individuals. And while the county in which this study was conducted has a major research university, which draws women from all over the world, we did not limit the inclusion criteria to only women who were born and raised in Appalachia because the purpose was to better understand the expectations of all women who reside in Appalachian Ohio. However, in future research we will compare the experiences of women who are born and raised in Appalachia compared to women from outside the region.

CLINICAL PRACTICE IMPLICATIONS

This was one of the first studies conducted to better understand how women learn about what to expect when they are pregnant in Southeast Ohio. While it is important for health care providers to assess the physical health of the mother and the unborn child, this study demonstrated that it is also important to assess what an expectant mother knows about pregnancy and what she expects to happen. If these expectations are not grounded in reality, then it is important for health care providers to help the woman understand what to anticipate emotionally, physically, and financially during the pregnancy. To that end, it is important that health care providers integrate other services within maternal and pregnancy care via referrals for counseling support, nutritional support, and social services support. Such integration ensures that clinicians are not overwhelmed, and patients do not fall through the cracks of health care services.

PUBLIC HEALTH IMPLICATIONS

In relation to pregnancy, overall maternal, infant and child health is a critical goal in ensuring the health of the public. According to Healthy People 2020, in order to ensure the well-being of the mother and child, pregnancy provides an avenue to recognize any prevailing health issues in women in order to mitigate future problems in this population. To that end, this study contributed to the existing body of research by providing pertinent information that expands on the larger maternal and child health issues. Participants' negative experiences were intertwined with their expectations not being met. For instance, participants who reported not receiving desired or needed information from their health care had an expectation (whether stated or implied) that they would get that information from their care provider. This is salient knowledge for public health efforts to better educate mothers, families and care providers of the need to consider and work to address factors, such as patients' expectations, doctors' patient load, and cultural competency, which can lead to conflicting expectations and experiences. From a public health perspective, this study found that a better understanding of the expectations and needs of pregnant women and examining their information-seeking behaviors, feelings regarding the support they received from doctors, family, friends, and others during pregnancy, can help align women's expectations and experiences. This could help to improve the likelihood of pregnant women experiencing and reporting more positive encounters as health care practitioners learn about women's pregnancy related expectations and work to manage those expectations by providing accurate information.

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RESEARCH BRIEF

Identifying Behavioral Health Needs of Individuals Screened at the Booking Counter of Montgomery County Jail

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ABSTRACT

Background: Many of the individuals who are released from incarceration are re-arrested and re-incarcerated within three years of release. Challenges that predispose individuals to re-arrest and re-incarceration include lack of education, employment opportunities, decent affordable housing, and treatment for substance use disorders (SUD) and/or mental illness. This report summarizes the behavioral health needs of newly arrested individuals in Montgomery County, Ohio.

Methods: For this project, 4,809 adult individuals arrested for non-violent crimes received behavioral health screening and case management at booking in the Montgomery County Jail. Criminogenic assessment using the Risk-Needs-Responsivity (RNR) tool was conducted with 484 arrestees. Descriptive statistics and chi square statistics were calculated for gender, race, referrals made, education level, employment status, housing status, alcohol and other drug use, and mental health status.

Results: As a group, the arrestees were undereducated, underemployed, and homeless. Based on RNR assessment, 67% had an SUD, and 60% required mental health treatment. Significant gender and racial differences were found among the arrestees, with women significantly more likely to have SUD and mental health issues.

Conclusions: Individuals arrested and booked into the Montgomery County Jail experience a complex interaction among mental health, poly-substance use, medical, employment, and housing needs that must be addressed in a comprehensive and coordinated funding manner. This interactive complexity of issues demand a response from an integrated service delivery system that would best benefit the person served and the community.

Key words: reentry population, substance use disorders, mental health, gender differences, racial disparities

INTRODUCTION

The social cost of incarceration is alarming. The State of Ohio spent over \$1.73 billion, or approximately 6% of the state's budget, to assess, house, secure, and service incarcerated individuals in state prisons in 2017.¹ In Montgomery County, Ohio, where this study was conducted, \$109 million, or over 70% of the county's general fund, was spent in 2017 on judicial and law enforcement services, including operation of the County Jail.² Many of the individuals who are released from incarceration (over 36.5% in Montgomery County) are re-arrested and re-incarcerated within three years of release.³ Recidivism, or the relapse into criminal behavior that results in re-arrest and re-incarceration, is a challenging issue in Montgomery County, which has a recidivism rate that is 1.19 times higher than the state recidivism rate of 30.7%.³

Returning citizens face a number of challenges that predispose them to re-arrest and re-incarceration, including lack of education, absence of adequate employment opportunities, a dearth of safe affordable housing, and need for treatment for substance use disorders (SUD) and/or mental illness.⁴ The destructive cycle of return and re-incarceration of large numbers of individuals creates unique health needs and risks for returning citizens and their communities. The Urban Institute, at its fourth National Reentry Roundtable, examined the public health dimensions of

reentry and concluded that most returning citizens return to poor neighborhoods where access to education, employment, and affordable, high-quality health care is limited.⁵ The most pressing health-related challenges included having no money for co-pays or deductibles, poor coordination of mental health and substance abuse services with health care, and racial and gender disparities in access to and quality of care. According to the findings of this Urban Institute Roundtable, returning citizens place demands on community health services for mental health services, SUD treatment, care coordination for multiple problems, and access to providers who have the skill set to treat the returning population.⁵

Most of those arrested and brought to the Montgomery County Jail are not receiving the behavioral health services that they require before or after arrest. The stays in the jail are relatively short, typically a few hours to a few days, so most offenders leave the jail without having their behavioral health needs addressed. This contributes to the high recidivism rate at the jail, because many offenders will re-offend due to untreated mental illness and/or co-occurring substance abuse. Most offenders return to the jail with the same barriers that they had prior to their last incarceration.

This report summarizes the behavioral health needs of newly arrested individuals in Montgomery County, collected in a reentry

program funded by a Bureau of Justice Assistance (BJA) grant. These findings inform about gender and racial differences in the need for behavioral health services by individuals who are released to society after arrest in Montgomery County.

METHODS

Setting

The Montgomery County Jail houses an average of 810 individuals (range = 672 – 935, for 2017-2018) and admits a mean of 60 arrestees (range = 15 – 116 for 2017-2018) daily.⁶ The increased rate of incarceration of women is a disturbing phenomenon in Montgomery County, and women now make up over 20% of the county jail population, up from 12% a decade ago, which has led to overcrowding in the women's housing pods. In addition, disproportionate numbers of African Americans are incarcerated at the county jail. While African Americans comprise 22% of the county population, the jail population is typically 48-53% African American; Hispanics comprise less than 2% of the jail population.

The Montgomery County Alcohol, Drug Addiction & Mental Health Services Board (ADAMHS) received a three-year BJA grant from the US Department of Justice in 2015 to provide wrap-around case management services to individuals at the County Jail at the time of booking for a non-violent offense. Case managers at the booking counter screened and collected information from newly arrested individuals regarding their need for medical and behavioral health treatment, housing, employment, education, food, clothing, and/or legal services. Most of these individuals were released within hours of their arrest and were provided with personalized packets that contained information regarding contact information and addresses of organizations that could help them obtain needed goods and services.

As part of this BJA grant project, an evaluation team from the Substance Abuse Resources and Disability Issues (SARDI) Program in the Department of Population and Public Health Sciences at the Boonshoft School of Medicine at Wright State University received de-identified data collected by the case managers at the booking counter at the County Jail. The SARDI evaluation team analyzed these data to identify trends in needed services and reported the results of these analyses to BJA. These data are summarized in this Research Brief.

Design

In a cross-sectional, non-experimental study that used convenience sampling methods to recruit participants, de-identified data collected by case managers at the booking counter were analyzed. Descriptive statistics included data regarding gender, race, education level, employment status, housing status, alcohol and other drug use, and mental health status.

Participants

Men and women (18 years and older) who had been arrested for a nonviolent offense and were booked into the Montgomery County Jail from October 1, 2016, to September 30, 2018, served as participants. Exclusion criteria included arrest for a violent offense, arrest for technical violation of supervised release, or booking for revocation of the terms of supervised release. Once they were determined to be eligible for the program, individuals who were arrested and brought into the Jail for booking were called to the booking counter by a case manager, screened for mental health and SUD treatment needs, and queried about additional needed services. Altogether 4,809 eligible participants received case management at booking. Most, however, refused criminogenic assessment. Data for 484 individuals (41 African American women, 178 White women, 99 African American men, 166 White men) who consented to criminogenic assessment are reported here.

Procedures

Case managers at the booking counter screened all eligible non-violent offenders with standardized screening tools, including the Patient Health Questionnaire (PHQ-2) for depression screening,⁷ General Anxiety Disorder (GAD-7) scale,⁸ and the CAGE-AID screener for SUD.⁹ Those who had received mental health treatment in the past and/or those who scored above the criterion on the PHQ-2, GAD-7, or CAGE-AID were asked to complete criminogenic assessment using the George Mason University Risk-Needs-Responsivity Simulation Tool.¹⁰

Measures/outcomes

Four valid, standardized instruments were used in this project. The Patient Health Questionnaire (PHQ-2) is a 2-item instrument designed to screen for depression.⁷ The General Anxiety Disorder (GAD-7) scale is a seven-item instrument that permits screening and severity measurement of anxiety,⁸ and the CAGE-AID screener is a four-item instrument designed to screen for alcohol and drug problems conjointly.⁹ The George Mason University Risk-Needs-Responsivity Simulation Tool (RNR) provided criminogenic assessment for more in-depth screening to develop treatment recommendations based upon criminogenic risk factors.¹⁰

Statistical Analysis

Descriptive statistics were calculated to summarize the number and types of referrals. Among those who completed the RNR, chi-square analyses were conducted for the following variables: gender (female versus male), race (African American versus White), referrals made (categories: medical treatment, behavioral health treatment, housing, employment, education, food, clothing, legal services), education level (categories: less than high school, high school graduate, some college, and college graduate), employment status (categories: full time, part time, unemployed looking for work, unemployed not looking for work, and not employed due to disability), housing status (homeless versus not homeless), alcohol and other drug use (categories: alcohol, opioid, meth and other amphetamines, marijuana, cocaine, and benzodiazepines), and mental health status (mental health diagnosis versus no diagnosis). Chi-square analyses were conducted to investigate the relationship of gender and race with the behavioral variables. Given the relatively large number of RNR measures analyzed, a Bonferroni correction was made, and alpha (significance level) was reduced from 0.05 to 0.008.

RESULTS

A total of 5,343 referrals were made for 4,809 unduplicated participants screened at the booking counter at the Montgomery County Jail. Of the 5,343 referrals, 10% were for mental health services, 13% were for SUD treatment, 13% were for housing, 16% were for employment services, 7% were for medical services, 2% were for educational services, and 38% were for referrals for other community resources (such as food, clothing, or legal assistance). Having a case manager in the booking area helped the arrestee to formulate a reentry plan. Case managers used motivational interviewing and, after realizing the case managers were not a part of law enforcement, many arrestees were more open to discussing treatment needs. Arrestees reported that their motivation for mental health treatment or substance abuse treatment was hampered by fears of medication, long-term treatment, and the stigma of being considered mentally ill. Many verbalized that mental health treatment was too lengthy and less effective than self-medicating. Some verbalized a preference to serve jail time instead of maintaining the efforts at staying clean in the community and being years on probation.

The sample of 484 arrestees who completed the RNR assessment was relatively undereducated, with 28% not completing high

school and 47% being high school graduates, compared to the general US population, which has a high school graduation rate of 90%.¹¹ Employment rates were also well below the American average, with 52% of the jail sample being unemployed and only 29% reporting full-time employment. Based on RNR assessment, 67% had an SUD, and 60% required mental health treatment. Less than 50% of the sample reported having housing.

Chi square analyses of data from the 484 individuals who completed the RNR revealed a number of significant relationships associated with gender and race for the behavioral variables measured. The most striking findings were related to gender differences. Women in this sample were significantly more likely to have mental health issues than were men, χ^2 (df = 1, n = 484) = 7.60, p = 0.006. Women were also significantly more likely to have a SUD than men, χ^2 (df = 1, n = 484) = 14.96, p < 0.0001. Men had a significantly greater need for housing than women did, χ^2 (df = 1, n = 484) = 30.55, p < 0.0001. In terms of racial differences found among arrestees at the Montgomery County Jail, white women were significantly more likely to have SUD than African American (AA) women, χ^2 (df = 1, n = 219) = 14.11, p = 0.0002. Table 1 summarizes all of the findings of the chi-square analyses conducted.

Table 1: Prevalence (%) of mental illness, substance use, unemployment, homelessness, and lack of education among arrestees who completed the RNR in the Montgomery County Reentry Project.

	Women			Men		
	White (n=178)	AA (n=41)	Total (n=219)	White (n=166)	AA (n=99)	Total (n=265)
Mental Health Diagnosis	68.8	60.0	67.1 ^a	56.4	50.4	54.2 ^a
Substance Use Disorder	81.9 ^b	52.5 ^b	76.5 ^c	62.5	56.1	59.4 ^c
Preferred Substance						
Alcohol	3.3	14.6	5.6	12.7	15.2	13.6
Opioid	45.8 ^d	4.9 ^d	38.0 ^f	24.1 ^e	9.1 ^e	18.5 ^f
Meth/Amphetamines	16.6	2.4	13.9	12.7 ^g	1.1 ^g	8.3
Marijuana	6.3	17.1	8.3	5.4 ^h	19.2 ^h	10.6
Cocaine	8.0	12.2	8.8	2.4	10.1	5.3
Benzos	1.1	0.0	0.9	0.6	0.0	0.3
Employment						
Full Time	15.3	27.5	17.6 ⁱ	33.5	34.7	34.0 ^j
Part Time	15.4	10.0	14.4	10.4	18.4	13.3
Looking for Work	26.7	42.5	29.6	23.7	17.3	21.4
Not Looking	31.8	17.5	29.2	23.1	20.4	22.1
Disability	10.8	2.5	9.2	9.1	9.2	9.2
Homeless	35.7	45.0	37.4 ^k	61.1	68.0	63.7 ^l
Education						
Less than HS	32.2	35.0	32.7	24.5	24.2	24.3
HS Graduate	33.3	42.5	35.0 ^k	58.2	57.1	57.5 ^k
Some College	33.9	22.5	31.8 ^l	17.3	17.5	17.4 ^l
College Graduate	0.6	0.0	0.5	0.0	1.2	0.8

Note: Numbers with the same superscript differ significantly by at least p < .008.

DISCUSSION

Individuals arrested and booked into the County Jail experience a complex interaction among mental health, poly-substance use, medical, employment, and housing needs that must be addressed in a comprehensive and coordinated funding manner. These findings corroborate the challenges for public health identified by the fourth National Reentry Roundtable sponsored by the Urban Institute.⁵ Special attention must be devoted to disparities associated with gender and racial subpopulations, in particular the higher need for SUD and mental health treatment by women. These disparities have been highlighted by numerous investigators, who relate the significantly higher prevalence of behavioral health disorders in incarcerated women to increased incidence of childhood trauma and physical, sexual, and emotional abuse experienced by women.¹²⁻¹⁶

PUBLIC HEALTH IMPLICATIONS

Public health has an important role to play in reducing recidivism. Individuals arrested and booked into the Montgomery County Jail experience a complex interaction among mental health, poly-substance use, medical, employment, and housing needs that must be addressed in a comprehensive and coordinated funding manner. This interactive complexity of issues demands a response from an integrated service delivery system that would best benefit the person served and the community. State and county public health officials must collaborate to develop and fund an integrated service system that meets the needs of returning citizens, particularly women, who experience SUD and mental illness at higher rates.

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RESEARCH BRIEF

Applying Publicly Available Contextual Factors to Predict Smoking Relapse in a National Sample

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ABSTRACT

Background: The ecological fallacy is broadly understood, though its complimentary problem, the individualistic or atomistic fallacy, is less often considered. Multilevel models offer the statistical tools needed to avoid both errors by allowing simultaneous consideration of individual, contextual, and policy factors. This study applies such methods to smoking cessation data. Tobacco control is of particular concern in Ohio where the adult smoking prevalence remains around 22%.

Methods: Data from the 1,785 participants in the Technology Enhanced Quitline Study were used to test the theory that contextual factors impact relapse rates and program effectiveness, employing a mixed-effects model to account for the nested nature of the data while testing for the relationship between contextual factors and relapse, controlling for individual characteristics.

Results: No contextual factors or policy variables were significant predictors of smoking relapse in the sample, nor were any associated with the success of the intervention.

Conclusions: While this work could not identify specific influences of contextual and policy factors on smoking outcomes in our sample, it demonstrates the feasibility of adding such predictors to future clinical trials. This project clearly does not rule out the possibility that contextual and policy factors may influence smoking even after controlling for individual characteristics, but does not provide strong evidence of such a link. It is possible that these negative findings may be due to geocoded mailing addresses being a poor proxy for relevant contextual factors, use of the wrong geographic unit of analysis (modifiable areal unit problem), or a lack of temporal resolution in contextual variables.

Key words: Tobacco cessation, multilevel modeling, contextual factors

(doi number goes here)

INTRODUCTION

For decades, researchers have been wary of the ecological fallacy, wherein aggregate results are assumed to apply to individuals.¹ There is increasing recognition that the opposite error, the individualistic or atomistic fallacy, may equally bias results.² Examining only individual factors and ignoring contextual ones gives an incomplete understanding. Multilevel models are statistical methods allowing simultaneous examination of individual and contextual factors.³

Despite a strong theoretical basis for examining contextual factors, few trials do so. Smoking cessation trials provide an example of this phenomenon. A PubMed search for clinical trials related to smoking or tobacco cessation, conducted by the authors in December 2018, returned nearly five thousand hits, yet only 64 abstracts (1.3%) included terms related to contextual factors or methods (“contextual,” “multilevel,” “multi-level,” or “neighborhood”). Though the percentage of trials exploring these questions has increased in recent years (2.1% past 10 years, 2.4% past 5 years), numbers remain small. This study explores the feasibility and utility of adding publicly available contextual data to the analysis of an existing tobacco cessation trial.

Numerous studies have identified individual level relapse predictors including substance abuse (e.g., use of other tobacco products, alcohol);⁴⁻⁶ demographic factors (e.g., age of smoking at relapse);^{7,8} psychological factors (e.g., depression, motivation to quit);^{5,9-12} and smoking characteristics (e.g., cigarettes per day, time to first cigarette).^{7,8,12,13}

A growing body of literature has explored how contextual factors influence smoking rates at the population level. Neighborhood characteristics (e.g., poverty, density of tobacco outlets) and tobacco policies have been associated with smoking prevalence.¹⁴⁻²¹ Policies influencing smoking initiation rates include the use of plain packaging and/or prominent, graphic warning labels on cigarettes, increased price of cigarettes through taxation, and institution of smoke-free policies.²²

This study examined whether publicly available data on contextual- and policy-level factors are associated with individual level smoking relapse, controlling for individual characteristics. Contextual variables were selected based on a review of the smoking literature. The impact of contextual factors on intervention outcomes was also examined by exploring the significance of interaction effects. Multilevel modeling was used to test the theory that contextual factors impact relapse rates and program effectiveness.²³

METHODS

Setting

This study was a secondary analysis of data from a clinical trial, Technology Enhanced Quitline (TEQ) Study,²⁴ supplemented by publicly available contextual data. The original study was conducted in collaboration with tobacco quitline operator Alere Wellbeing, Inc (AWI).

Participants

Participants were recruited from 19 AWI client businesses. Individuals employed by these businesses who voluntarily utilized quitline benefits through their employer or health plan benefits package were invited to join the study upon reporting at least 24 hours of abstinence following their quit date. To be eligible, they needed to be English-speaking adults with access to a touch-tone phone. AWI's services are utilized by organizations with a national reach, yielding a geographically diverse sample. As participants were recruited through AWI clients, all were either employed by those clients or dependents of such employees.

Design

Detailed information about the study design has been previously reported.²⁴ Briefly, the TEQ Study was a randomized trial testing the efficacy of an automated telephone intervention to improve quit success among users of tobacco quitlines.

Upon enrollment, participants were randomized to either: standard quitline treatment, a low intensity intervention (standard treatment plus 10 automated check-ins), or an intensive intervention (standard treatment plus 20 automated check-ins).

Measures

TEQ participants reported demographics, psychological characteristics (i.e., depression, motivation to quit), smoking characteristics (i.e., cigarettes per day, time to first cigarette), past quit attempts, and social network smoking (i.e., exposure to smoking at home and work) at baseline. They were assessed for smoking status at 6- and 12-months post intervention. Participants who reported smoking even a puff during the past 7 and 30 days were defined as having relapsed.

Contextual factors, gathered at the county level, were collected from publicly available data sets. Demographics were drawn from the Robert Wood Johnson Foundation's County Health Rankings Database.²⁵ Tobacco production, tobacco outlet density, and community demographic data were derived from government sources like the USDA's National Agricultural Statistics Service and US Census.^{26,27} Tobacco policies, tobacco taxation, and cessation and prevention spending information were gathered from resources released by advocacy groups including Americans for Nonsmokers Rights publications²⁸ and Campaign for Tobacco Free Kids,²⁹⁻³² supplemented by government website data.³³

Procedures

The investigators used standard address matching procedures in ArcGIS 10.2 (ESRI, Redlands, CA) to assign each individual to specific geographic coordinates using the participant's residential address. These coordinates were used to link the participant to contextual and policy level factors using geographic information system overlay procedures.

Procedures were approved by Institutional Review Boards at Indiana University and Bluffton University. All participants enrolling in the original study provided verbal informed consent and authorization for the TEQ investigators to use protected health information.

Statistical Analysis

A mixed-effects model was used to account for the nested nature of the data (individuals nested within counties). Given the binary nature of the outcome (i.e., relapse or no relapse) a binomial error distribution and a logit link function was used to produce a generalization of a logistic regression model. Models were fit using the SAS® GLIMMIX procedure (SAS Institute, Cary, NC).

The primary aim was to determine if contextual factors were associated with smoking relapse while controlling for individual-level effects. The significance of adding contextual factors one-at-a-time to a base model containing all individual factors and treatment status was tested. A cutpoint of $\alpha=0.05$ was used to determine significance of adding each variable. A second aim examined whether the effect of the intervention varied based on the context in which it was implemented. This was done by testing the significance of a contextual factor-by-intervention interaction term in a base model including all individual factors, intervention group, and a main effect for the contextual factor. A cutpoint of $\alpha=0.05$ was also used to determine significance of interaction effects.

Multiple imputation was utilized to account for missing data,³⁴ as this approach theoretically provides less biased estimates.³⁵ Values for missing data both for predictors and outcome variables were estimated using existing data.³⁵ This process was repeated ten times, and cumulative results summarized with SAS PROC MI-ANALYZE.³⁶ Sensitivity analyses were conducted using two alternative methods for dealing with missing data: a respondents-only analysis (assuming information is missing completely at random) and "traditional penalized imputation" in which non-responders to data collection are considered relapsed.³⁷ The primary analysis using multiple imputation has slightly greater power because, like penalized imputation (missing=smoking), it uses all persons with baseline data but, compared to penalized imputation, it uses more information and produces results with greater power, less bias, and greater accuracy than penalized imputation or responder-only analysis.^{35,37}

RESULTS

The TEQ sample included 1,785 participants from 47 states and the District of Columbia (Figure 1). Alaska, Hawaii, and Wyoming had no participants. Participation rates elsewhere ranged from around 0.1 per 100,000 population in Rhode Island to 3.4 per 100,000 population in Minnesota.

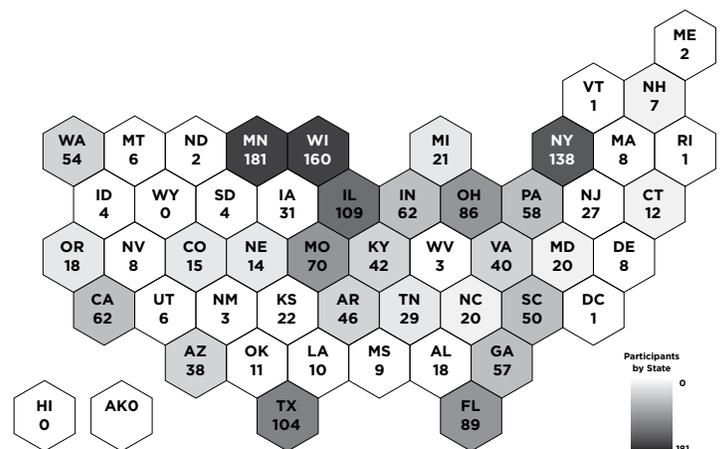


Figure 1. Number of Technology Enhanced Quitline (TEQ) Study participants by state.

Relapse rates at 6 and 12 months ranged from 32-44% depending on the treatment exposure, time point, and outcome measure. Prior to the addition of contextual factors, age, motivation to quit, depression, cigarettes per day, and social network smoking were significant predictors of relapse.²⁴ Table 1 displays odds ratios for relapse (smoking even one puff) for both 7- and 30-day periods prior to each follow-up interview (6- and 12-months). No contextual factors or policy variables were significant predictors at either time point.

Table 1. Adjusted odds ratios (95% Confidence Interval) describing the change in risk of relapse per change in contextual factor* in a geographically diverse sample of United States smokers attempting to quit.

Contextual and Policy Factors	6-month survey outcomes		12-month survey outcomes	
	Smoked in last 7 days	Smoked in last 30 days	Smoked in last 7 days	Smoked in last 30 days
Unemployment ²⁵ Per 5% increase	1.11 (0.84, 1.46)	1.01 (0.73, 1.38)	1.19 (0.91, 1.56)	1.09 (0.81, 1.47)
Clean indoor air legislation ²⁸ Comprehensive vs. no comprehensive ban	1.13 (0.88, 1.46)	1.08 (0.83, 1.40)	1.05 (0.82, 1.35)	1.12 (0.88, 1.41)
Tobacco tax rate ^{29-31,33} Per \$1 increase	1.08 (0.97, 1.20)	1.04 (0.94, 1.16)	1.02 (0.92, 1.13)	1.00 (0.90, 1.11)
Violent crime rate ²⁵ Per 100 crimes/100,000 people increase	1.02 (0.97, 1.06)	1.01 (0.97, 1.06)	1.01 (0.96, 1.06)	1.01 (0.97, 1.06)
Tobacco production ²⁶ Tobacco producer vs. non-producer	0.81 (0.56, 1.18)	1.03 (0.72, 1.49)	0.90 (0.61, 1.31)	0.97 (0.69, 1.36)
Smoking prevalence ²⁵ Per 5% increase	0.94 (0.84, 1.05)	0.99 (0.89, 1.10)	0.94 (0.84, 1.06)	0.99 (0.88, 1.10)
Tobacco retailer density ²⁷ Per 1 outlet/1000 population increase	0.92 (0.61, 1.40)	0.96 (0.64, 1.46)	1.10 (0.77, 1.59)	1.18 (0.82, 1.68)
Tobacco control funding ³² Per 25% of CDC target increase	0.96 (0.73, 1.25)	0.93 (0.73, 1.19)	0.98 (0.77, 1.23)	1.02 (0.79, 1.32)

*Controlling for individuals' age, sex, race, ethnicity, education, cigarettes per day, time to first cigarette, number of quit prior attempts, duration of longest quit attempt, motivation, depression, social network smoking, and treatment status.

Sensitivity analyses examining the impact of alternative ways of addressing missing data yielded similar results, with one exception. When limiting analyses to respondents without missing data (respondent-only analysis), significant effects were observed for presence of a comprehensive clean indoor air policy and increasing tobacco tax rates at the 6-month follow-up. Unexpectedly, odds ratios for both factors were greater than 1, indicating an increased likelihood of relapse for individuals in regions with comprehensive clean indoor air policies and higher tobacco tax rates. However, no contextual factors were significant when conducting a traditional penalized imputation analysis (missing = relapsed). No significant interactions, indicating contextual impacts on intervention effectiveness, were observed.

DISCUSSION

This study did not find a significant relationship between policy or contextual factors and smoking relapse. Sensitivity analyses were generally consistent with the main analyses using multiple imputation. Although respondent-only analysis revealed two contextual findings, research has shown that such results are generally biased and less trustworthy compared to the multiple imputation results. While this project has some suggestive findings, and clearly does not rule out the possibility that contextual

and policy factors may influence smoking, it does not provide strong evidence of such a link. In considering these negative findings, several possibilities apart from a lack of effect should be considered.

First, geocoded mailing addresses may be a poor proxy for the contextual factors most relevant to individuals. This has been termed the uncertain geographic context problem.³⁸ Individuals work, play, worship, shop, and carry on many other activities outside the home. Exposures in these areas may be more important than those in the home context. As the sample is composed solely of individuals with insurance provided through an employer or health plan, this effect may be more pronounced, as a majority of participants work outside their homes. Additionally, we lack information on residential duration, so individuals may have recently moved to or from the utilized address.

The modifiable areal unit problem presents an additional challenge.³⁹ When utilizing geographic data, it is difficult to know the correct geographical unit of analysis. Is someone defined by their block group, census tract, zip code, or county? Such questions have not been definitively answered. In this preliminary research, the unit of analysis was often constrained by the availability of data. Where available public data made it possible, we compared the results using measures at several levels (including block group, county, and state). These analyses yielded similar results, though this is an area meriting further exploration.

Temporal factors may have contributed to the negative findings. Contextual data is generally gathered in cross-sectional snapshots, often at one-year intervals. We used data gathered during the study period; however, it is possible that certain contextual factors may have shifted shortly before or after a participant's involvement in the study. An additional consideration is whether changes in contextual factors might be as important as or more important than specific values. For example, a newly imposed smoking ban may be better (or more poorly) enforced than an established ban, or a recent increase in cigarette taxes may initially seem more onerous than it does after a period of adaptation. Incorporating information about the timing of policy implementation may reveal relationships that are masked by cross-sectional measures.

PUBLIC HEALTH IMPLICATIONS

Smoking remains a vital health issue in the state of Ohio. Nationally, adult smoking prevalence has declined steadily from more than 40% to 14% since the mid-1960s.⁴⁰ Rates have generally declined in Ohio as well; however, gains have stagnated in recent years, with the smoking prevalence in the state remaining around 22% since 2014,⁴¹ leaving Ohio with the sixth highest smoking rate in the United States.⁴² Better understanding the impact of contextual factors on smoking relapse could play a vital role in targeting interventions and shaping healthier communities.

This project tested the hypothesis that contextual and policy factors captured by publicly available data sets would measurably impact the risk of relapse, even after controlling for individual characteristics; however, the current study did not find such factors to add significant predictive power among a national sample of corporate quitline clients in a clinical trial. Technical and theoretical developments have ushered in an era of "big data." The increasing ease with which contextual data may be captured, stored, shared, and analyzed will allow for further examinations of the impact of contextual factors on smoking and other public health outcomes. While this work could not identify specific influences of contextual and policy factors on smoking outcomes in our sample, it demonstrates the feasibility of merging publicly available contextual data into future clinical trials to further explore the role of policy and environment on smoking and other health behaviors.

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RESEARCH BRIEF

Communication Preferences of Young Adults During “Do Not Drink” Water Emergencies

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ABSTRACT

Background: Rapid, accurate communication between public health officials and the community members they serve is essential for public health protection and safety. “Do not drink” water advisories are public health emergencies that periodically occur in Northwest Ohio. The City of Toledo issued a “do not drink” advisory to approximately 400,000 residents in August 2014. Most families learned about the “do not drink” advisory from television news networks. However, communication preferences among young adults differ greatly from older generations. The purpose of this study was to identify young adult communication preferences during public health emergencies such as “do not drink” water advisories.

Methods: A cross-sectional survey was used to gauge young adults’ preferred method of communication during public health emergencies and to ask how they have learned about health advisories in the past. The questionnaire was administered electronically to 330 college students at a mid-size public institution in the Midwest.

Results: A total of 291 surveys were collected (88% response rate). When asked “If you have experienced a “do not drink” advisory or other public health emergency, how did you hear about it?” the majority of students (69%) reported television news stations (38%) or Social Media/Facebook (31%). When asked “how would you like to be notified during a public health emergency such as a “do not drink” water advisory?” the majority (70%) preferred text messaging.

Conclusions: Communicating rapidly with members of the community during public health emergencies is vital. Text messaging may be the best way to quickly disseminate critical information to young adults.

Key words: Health communication, young adults, texting, social media

INTRODUCTION

Social media, such as Facebook, Twitter, Instagram, and Snapchat, are changing the ways in which many members of society communicate with one another. An estimated two-thirds of college students in the U.S. and three-quarters of Internet users report daily use of one or more social networking sites with Instagram being the most frequently used platform.¹ This increased use of social media offers opportunities for public health officials to disseminate vital information to community members. It is becoming more common for health departments to communicate health information using social media.² The Social Media Adoption (SMA) study, which analyzed direct use of social media outlets by local health departments, described how local health departments use Facebook and Twitter to communicate with community members.³ Almost 25% of local health departments included in the study reported using Facebook, 8% used Twitter, and 7% reported using both. The authors concluded that local health departments and the communities they serve can benefit from the rapid and bi-directional communication provided by social media platforms.

Public health officials need to keep pace with changing technology trends by evaluating and updating their current health communication strategies. Before new practices are tested, officials should consider that social media use is not evenly distributed across the major U.S. generational cohorts.⁴ For example, text messaging has emerged as a particularly common mode of communication among the members of younger cohorts. Evidence suggests that individuals in the millennial cohort (those born between 1980 and 2000) send or receive a minimum of six texts

each day.⁵ The use of “texting” to rapidly alert members of the public has been successfully used during missing children⁶ and severe weather⁷ events and should be employed more frequently during public health emergencies such as active shooters and natural disasters.

Drinking water contamination also constitutes a public health emergency. In August 2014, dangerous levels of microcystin toxin were found in the drinking water of Toledo, Ohio as a result of a harmful algal bloom event at the municipal water supply intake in Lake Erie.⁸ Through traditional and social media outlets, residents were informed not to drink city water. Public response bordered on panic with some residents quick to deplete local and regional supermarkets and other stores of all bottled water supplies.⁸ After the emergency, the Community Assessment for Public Health Emergency Response (CASPER) study was conducted and presented by the Ohio Department of Health and the Toledo-Lucas County Health Department.⁹ The CASPER study analyzed how word of the water emergency spread among the metro Toledo community. The majority of households (80%) reported learning about the “do not drink” advisory through television (TV) media outlets. However, as previously noted, communication preferences and behaviors vary greatly by generational cohort.⁵ The present study focused on preferred methods of receiving vital information during a water emergency such as the 2014 Toledo incident. Specifically, we examined the communication preferences of young adults during a hypothetical “do not drink” water advisory. The research question to be answered was the following: How do young adults prefer to be notified of a drinking water emergency?

METHODS

Setting and Design

The Institutional Review Board at Bowling Green State University approved the research protocol. A cross-sectional survey design was employed. A 19-item questionnaire was developed and reviewed by two experts in survey research methodology for face and content validity. The questionnaire was administered electronically to a convenience sample of college students at Bowling Green State University during spring semester 2017.

Participants

Participants (n=330) were recruited directly from six undergraduate public health courses and one graduate course in public health administration as well as through an email sent to undergraduate business students active in a campus professional organization.

Procedures

A list of courses was obtained from faculty willing to allow the researchers access to their classrooms. Researchers visited seven classrooms to explain the study and invite student participation. After all questions about the study were answered, the link to the electronic survey was displayed on the classroom projector screen. The details of the study, including risks and benefits of participating, were explained on the first page of the online survey. Students were informed that completing the survey and clicking on the submit button constituted their consent to participate. Students were allowed ten minutes at the beginning of class to fill out the survey using their mobile devices or laptop. Course instructors sent email reminders to students the next day to encourage participation by students who were not in class or did not own or bring their mobile device/laptop the day of data collection. Undergraduate business students involved in the professional organization were sent the survey link via email along with a reminder email the same week.

Measures

The questionnaire asked about race, family structure, home ownership, education level, and the home's primary drinking water source (municipal water, well, purchased bottled). The questionnaire also described a "do not drink" advisory as an example of a public health emergency and provided participants with six potential notification options from which they were instructed to choose one: print newspapers, online news articles, radio, social media/Facebook, text messages, or TV news stations.

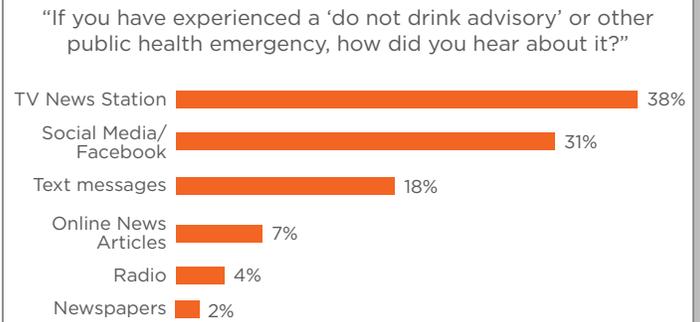
Statistical Analysis

Response rates for the various notification options were calculated using the survey software's onboard tools.

RESULTS

We collected 291 usable surveys (88% response rate). Seventy-eight percent of students identified as White, 18% as Black, 4% as Asian/Pacific Islander, and 7% as other. All participants were over the age of 18 years and younger than 65. The majority of participants (n=261) were traditional college students enrolled in undergraduate sophomore and junior level courses. We collected 30 additional surveys from one graduate level course in public health administration. Figure 1 depicts responses to the question "If you have experienced a "do not drink" advisory or other public health emergency, how did you hear about it?"

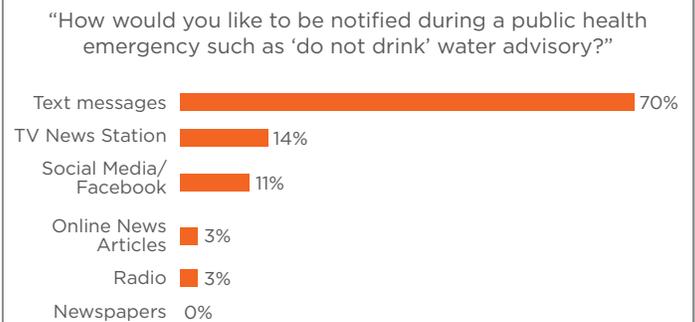
Figure 1: Communication methods reported by young adults during past public health emergencies



The majority of participants (69%) reported learning about public health emergencies through either traditional TV news stations (38%) or social media/Facebook (31%). Text message notification was reported by 18% of participants.

When confronted with a hypothetical "do not drink" water scenario and asked to identify their preferred communication method, 70% chose text messaging compared to 30% for all other communication modalities combined, including social media/Facebook. Figure 2 depicts communication preferences during a "do not drink" water advisory.

Figure 2: Communication methods preferred by young adults during a "do not drink" advisory



DISCUSSION

Rapid and accurate communication during drinking water emergencies are of the utmost importance to safeguard the health of all community members. In the present study, college students overwhelmingly identified texting as their most preferred method of notification during a "do not drink" advisory. This preference is in direct contrast to how these students reported actually hearing about past public health emergencies and also conflicts with the SMA study findings.³ This may be due to the fact that the SMA study is six years old and communication preferences have changed in the meantime. The fact that TV news media was the notification method most frequently recalled by those who had actually experienced a public health emergency in the past supports the CASPER study findings.⁹ It should be noted that because the majority of participants resided within Wood or Lucas county in Ohio, it is likely that the water emergency they were recollecting was the "do not drink" advisory issued by the Lucas County Health Department in Toledo in August 2014. Regardless, public health officials, in addition to using social media outlets, should consider implementing a text message alert system linked to the community's existing Emergency Alert System (EAS) in order to effectively communicate water emergencies information to

young adults. Individuals belonging to the millennial generation, such as the students in the present study, perceive text-based warning messages to be more serious and valid than alerts posted on social media outlets.¹⁰ For maximum impact, care must be taken to ensure the emergency text message includes information on how the recipient can protect themselves and that the text is sent from a number recognizable to the recipient.¹¹ Seattle and King counties in Washington state have implemented texting systems that can serve as useful models.¹² However, developing a community text alert system to reach younger residents may have limited utility for members of older generational cohorts, such as Baby Boomers, who tend to use Facebook more frequently than younger individuals.¹

In addition, as a result of climate change and irresponsible agricultural practices, harmful algal blooms may increase in frequency and severity in the future leading to a corresponding increase in drinking water emergencies.¹³ Rapid communication of “do not drink” advisories on a mass scale, particularly in communities who depend on lakes for municipal drinking water supply, will be of paramount public health importance in the future.

There are several limitations with this study. Participants were selected from a single institution in the Midwest and may not reflect the views of all young adults. The questionnaire was administered electronically during class time. Students may have felt pressure to complete the survey quickly causing them to misremember past events. Recall bias and providing socially desirable responses are also limitations of all survey research. While the response rate of 88% was highly acceptable, the total convenience sample of 291 may not accurately reflected all young adults’ views on emergency communication, especially those not enrolled in college. Additionally, only students majoring in allied health sciences or business were queried. Due to limitations of the survey software, assessing communication preferences by demographic characteristics was not possible. Future studies should include students from all academic majors and geographic areas in order to improve generalizability of results. Young adults not enrolled in college should also be surveyed to better understand their preferred modes of communication.

PUBLIC HEALTH IMPLICATIONS

Despite the use of social media seemingly increasing by the day, it is interesting to note that social media may not be the preferred method of communication by adults during a water emergency such as a “do not drink” advisory. Results from the present study suggest text messaging may be the method of choice for community members born after the year 2000. Disparity between the public’s communication preferences and communication methods used by health officials limits the accuracy and speed at which life-saving information is delivered. Traditional media, such as TV news stations and newspapers, remain valuable allies for public health communications. Performing periodic survey studies is crucial to following the ever changing communication preferences of the community members we serve.

Health department officials understand the importance of using communication methods that quickly and accurately disseminate information to community members. For young adults, text messaging may be the best method. Texting official recommendations during “do not drink” water advisories could help vital information quickly reach more members of the community. To ensure that text messages are received, mandatory inclusion of

“do not drink” water alerts into the existing Emergency Alert System (EAS) is recommended. We also encourage public health officials to increase their presence on social media and to use text messaging more frequently to interact with young adults and to answer questions during public health emergencies. Public health officials should continuously review and adapt their communication strategies as technology improves and changes.

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PUBLIC HEALTH PRACTICE

Using the Pathways Community HUB Care Coordination Model to Address Chronic Illnesses: A Case Study

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ABSTRACT

Background/Objectives: Ohio communities are developing and expanding care coordination initiatives to integrate care for low-income pregnant women. Some of these initiatives are guided by the Pathways Community HUB model, which uses community health workers to address health, social, and behavioral risks for at-risk populations. This study documents the development, challenges and management responses, and lessons learned from implementing a Pathways Community HUB care coordination program for another population -- low-income adults with chronic disease risks.

Methods: The study utilizes data extracted from the Care Coordination Systems (CCS) database used in Lucas County, Ohio between 2015 and 2017 and interviews with program managers. Based on CCS data and insights from those interviewed, we describe the development and accomplishments of a Pathways Community HUB program for adults with chronic illnesses and identify challenges and lessons learned.

Results: The Toledo/Lucas County program addressed more than half of 3,515 identified health and behavioral risks for 651 low-income adults in the program during its first two years of operation. Key challenges included building community support, establishing capacities to coordinate care, and sustaining the program over time. Establishing community networks to support program services and developing multiple funding sources are key lessons for long-term program sustainability.

Conclusions: Documenting challenges and successes of existing programs and extracting lessons to guide implementation of similar public health efforts can potentially improve delivery of interventions. The Pathways Community HUB model has demonstrated success in addressing risks among at-risk adults. However, more comprehensive assessments of the model across different populations are warranted.

Key words: Pathways Community HUB model, care coordination, chronic illness, risk reduction, low-income

INTRODUCTION

Organizations across Ohio and nationwide have implemented healthcare coordination initiatives to expand access to needed services, reduce costs, and improve outcomes. This article addresses the development of a Pathways Community HUB care coordination program for low-income adults with chronic illnesses in Ohio. A HUB is an impartial autonomous entity that has a role in coordinating care for at-risk clients.¹ It serves as a linkage point for a network of community based organizations (CBOs) that provide services for at-risk populations and it is responsible for monitoring and improving quality of care coordination services. Through the HUB model, payments are aligned with measured outcomes.

The Pathways Community HUB model originated in Richland County, Ohio, in 2002, and it has expanded to more than a dozen Ohio locations and to at least five other states. Fueling this expansion is evidence showing the model successfully prevented low birth weight (LBW) births in Richland County,² and the enactment of state legislation (SB 332) to establish a system of qualified HUBs throughout Ohio to serve at-risk pregnant women. In Ohio, Medicaid Managed Care (MMC) plans also support services for certain Medicaid clients served by certified CHWs working for

“a qualified community HUB.”³ The Ohio Commission on Minority Health has also funded HUBs focused on addressing the needs of pregnant women.³ As a result, a number of Ohio communities now operate HUB programs serving low income pregnant women, and existing evidence suggests that these HUBs are effective in improving birth outcomes.^{2,4}

This article presents a case study suggesting that the Pathways Community HUB model may also be used productively to help coordinate care for low income adults with chronic illnesses. It offers evidence that a HUB program in Lucas County, Ohio, has aided the integration of low-income adults into health and social service systems that identify and mitigate their individual risks. It also identifies challenges associated with these efforts, responses to address these challenges, and lessons for others who want to extend care coordination initiatives to address health risks for low-income adults with chronic illnesses.

Healthcare coordination can be viewed broadly as the organization of patient care across more than one service provider to facilitate delivery of health-related services.⁵ Studies suggest that it holds potential for improving healthcare quality and reducing costs.⁵⁻⁸ The Pathways Community HUB model uses Community Health Workers (CHWs) to help coordinate client care. CHWs

are typically members of the targeted sub-population(s) and have been shown to be effective in reaching at-risk audiences and implementing new models of care coordination.⁹⁻¹¹ The Ohio Board of Nursing regulates the certification of CHWs throughout Ohio. To build its CHW workforce to address chronic illnesses, the Lucas County HUB and its partners recruited individuals from the targeted audience and hired them using public recruitment efforts. They also recruited potential CHWs through informal networks of social service agencies such as the Salvation Army, Food Banks, Community Action Agencies, and – in some cases – by engaging with former HUB clients as well.

Under the HUB model, CHWs perform a structured assessment of clients' health needs using standardized tools and "Pathways" to link beneficiaries to community resources and track outcomes.^{1,2,12} They also identify and assist clients in mitigating their risks through completion of identified Pathways, which helps ensure accountability for progress and serves to support coordination among all parties involved in an individual's care.¹³ The HUB model tracks the progress of interventions to mitigate identified risks ("Pathways"), and the completion of Pathways defines measurable outcomes compensated through payments tied to the mitigation of patients' risks. The uniqueness of the Pathways Community HUB model lies in the breadth of risks it addresses (social, behavioral, and medical), the tracking of progress and outcomes at the individual level, and the connection between confirmed risk mitigation and payments for the CHWs who coordinate services.^{1,13}

While the Pathways Community HUB model has demonstrated success in addressing needs of at-risk pregnant women, some Ohio communities are using it to address another key health need – management of chronic illnesses for at-risk adults. The 2017-2019 Ohio State Health Improvement Plan (SHIP) identified chronic disease as one of three priority drivers of poor health status, premature death, and unsustainable healthcare.¹⁴ It also recommended that efforts to address social determinants of health be undertaken. Pathways Community HUB programs follow up on this recommendation by addressing social, behavioral, and health risks.

To improve interventions for low-income adults with chronic illnesses in Ohio, it makes sense to learn about the challenges and successes of existing programs and extract lessons to guide similar public health efforts in other settings. While there are manuals which help communities understand steps to develop Pathways Community HUBs¹ and several assessments of HUB programs suggested positive impacts in their communities,^{2,4,15,16} there is no known literature documenting the development, challenges and management responses, and lessons learned from implementing the model for low-income adults with chronic illnesses. In addition, because adults with chronic illnesses may be less acutely affected by their risks/illnesses than pregnant women are affected by their condition, there is reason to believe that the challenges of using the HUB model to coordinate care for adults with chronic illnesses may differ from the challenges for pregnant women who have often been the subject of Pathways Community HUB programs. It therefore seems sensible to investigate use of the Pathways model for this population. In this article, we undertake this task.

METHODS

Setting

The study was conducted in Lucas County, Ohio. According to U.S. Census Bureau 2017 estimates, Lucas County, located in Northwest Ohio, has a population of 430,887 people and a median household income of \$44,820 (2017 dollars).¹⁷ Its population is 20.1% African American, 74.6% White, and 5.3% other races. Approximately 11% of the population has less than a high school education.¹⁷ The most recent Community Health Assessment

(CHA) of Lucas county reports that 74% of Lucas County adults were overweight or obese based on Body Mass Index.¹⁸ Additionally, the county's reported 36% obesity rate exceeds the 30% obesity rate reported for Ohio and the United States.¹⁸ The Lucas County CHA also reports higher rates of obesity, diabetes, asthma, and hypertension for its African American population than for its White population.¹⁸

Procedures

This case study emerges from a program evaluation conducted for the Hospital Council of Northwest Ohio (HCNO) and the Centers for Disease Control and Prevention (CDC) between 2015 and 2017, and interviews and follow up communications with key HUB officials in 2018 and 2019. The evaluation relied on quantitative data extracted from the Care Coordination Systems (CCS) database used to support the HCNO program in Lucas County, and insights provided by HUB staff. The data include information on engagement of health systems and service providers in the Pathways Community HUB care coordination program, participation and enrollment, staffing, Pathway assignments and completion rates, and other information yielding insights on the development of the program, the challenges it faced, and how those challenges were addressed. Data downloads were made 6, 18, and 24 months after program inception, and data from these downloads underlie the information presented in this article. Where appropriate, we supplement information from this program evaluation with information pertaining to other Pathways Community HUB programs.

We conducted targeted interviews with HUB staff and CHW supervisors in 2018 to gain insight into the Lucas County program's evolution and sustainability, as well as into challenges, management responses, and lessons learned. Participants were asked questions relating to planning, implementation, program growth, challenges and management responses, lessons learned, and program sustainability. Follow up communications provided further clarifications as needed.

Measures/Outcomes

Our case study addresses quantitative and qualitative outcomes. Qualitative outcomes investigated include challenges and lessons learned in implementing the Pathways HUB model, including those relating to client participation and services received. We use various quantitative measures to describe the program's development, including the number of clients referred and receiving Pathway assignments in the program and measures of risk reduction as demonstrated by Pathway Mitigation Success Rates and Workload Production Rates.

Statistical Analysis

Descriptive analyses of the program's development were performed using SAS software version 9.4 (SAS Institute, Cary, NC, USA). For the qualitative component of the study, content analysis was used to analyze data collected through in-depth interviews and associated follow-up inquiries.

Institutional Review Board Approval

A university Institutional Review Board approved the study protocol.

RESULTS

The 2013/2014, Lucas County CHA revealed chronic disease outcomes that ranked lower than Ohio and the nation¹⁹ and it provided impetus to expand Lucas County's existing Pathways Community HUB program to low-income adults with or at-risk for chronic illnesses. The initial community-wide Northwest Ohio Pathways HUB was launched in 2007 to serve at-risk pregnant women. The HUB is a regional clinical-community linkages system administered by the Hospital Council of Northwest Ohio (HCNO), which contracts with care coordination agencies throughout the

community that employ CHWs to connect low-income residents to needed medical, social, and behavioral services. HUB staff provide trainings for CHWs and their supervisors, as well as contracts for outcome-oriented services, data tracking, and other administrative services. Below, we describe development of the HUB program for low-income Lucas County adults with or at-risk for chronic diseases, identify challenges associated with the program's development and implementation, and outline management responses to these challenges. We also discuss lessons learned. Our analysis focuses on three stages of the program's development: 1) planning; 2) implementation, and; 3) positioning for long-term sustainability.

Planning

In planning the adult chronic disease program, HCNO's HUB managers faced two key challenges: building support and establishing capacities to reduce risks for clients. Effective care coordination requires community support in the form of both services for the targeted population and funding resources. HCNO benefited from existing Lucas County efforts to address community health needs, including the HUB's establishment to serve at-risk pregnant women and improve birth outcomes. The Toledo Community Foundation and the Stranahan Foundation provided initial financial support for HUB efforts to improve birth outcomes in Lucas County. Key stakeholders were also engaged to help develop a successful grant application to the Centers for Disease Control and Prevention (CDC), which yielded base funding for three years to develop and initiate a program to serve adults with or at-risk for chronic diseases. Drawing on community support and federal resources, HCNO's HUB program issued a Request for Proposals to identify and subsidize key CBO partners to become care-coordinating agencies (CCAs) for adults with chronic diseases and provide care coordination services. By the end of 2015, HCNO had engaged four of the seven health systems in Lucas County,²⁰ and had developed additional support from other health and social service providers.

HUB managers at HCNO also faced the challenge of building capacities to enroll participants and identify their risks, as well as empower participants to address and reduce their risks. This meant hiring and training staff and establishing tracking capacities to coordinate care for clients. Contracted CCAs hired CHWs from among individuals in the targeted low-income adult population, and the HUB worked to ensure these CHWs received training needed to achieve and maintain certification from the Ohio Board of Nursing. CHWs were trained to understand their roles in recruiting and enrolling clients, completing checklists to identify risks and Pathways needed to address those risks, making referrals to community stakeholders to address the risks identified, and entering data into a database to track and coordinate service delivery. To support this effort, HCNO's HUB contracted with CCS, a private vendor that developed the database. By the end of 2015, the HUB was supported by at least seven trained CHWs,²⁰ who were recruiting low-income adult clients and working to reduce these individuals' chronic disease risks.

Implementation

HUB managers at HCNO also faced implementation challenges. Enrolling and engaging clients, identifying and mitigating risks through Pathway completion, and managing data entry and extracting information from the CCS database to support program improvements all posed challenges.

a) Enrollment and engagement in the program

The HUB identified prospective clients through canvassing conducted by CHWs and referrals from healthcare providers, hospitals, managed care organizations, and other external agency partners. In the first six months of the program, 177 clients were engaged, and participation – as measured by referrals into the program – accelerated to 757 individuals after two years. Of the 757 referred participants, 651 individuals actually received Pathway assignment services. Figure 1 displays the growth pattern in the program's participation over its first two years of operation.

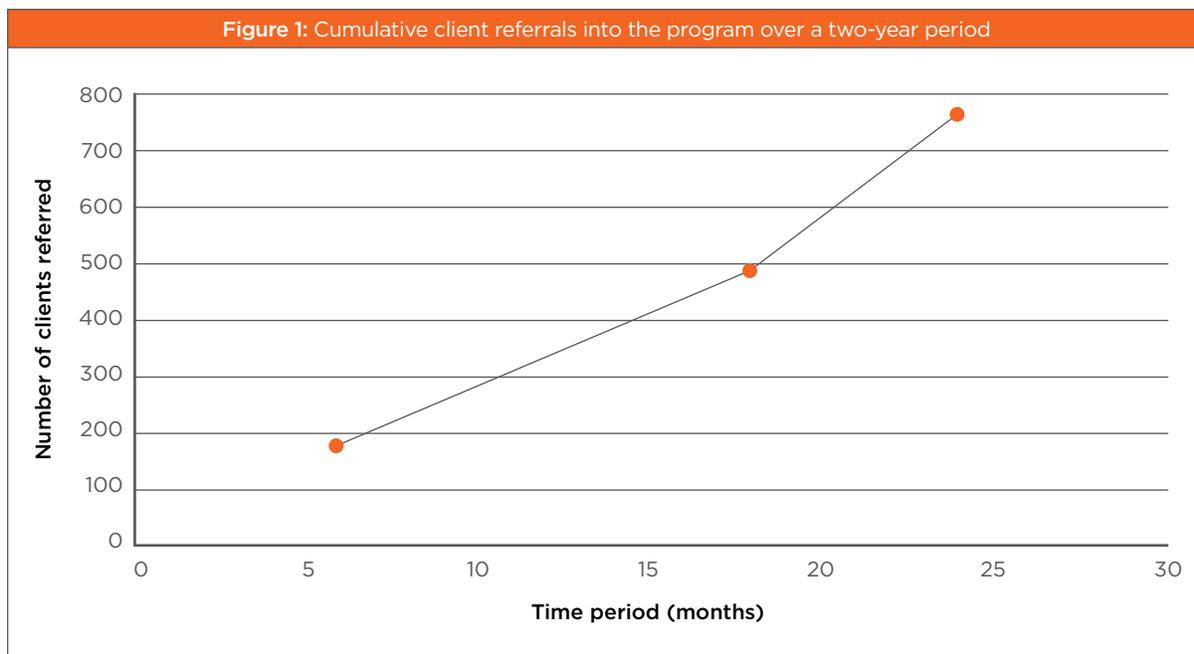


Table 1 summarizes characteristics of the individuals referred to the program during its first two years. Low-income Lucas County adults with or at-risk of chronic illnesses, particularly African Americans were disproportionately affected. The majority were female (65.9%), Black/African American (52.2%), had a high school education or less (60.8%), had an annual income of less than or equal to \$10,000 (53.4%), and were not employed (69.9%). At an average age of 51 years, participants often had multiple chronic conditions (mean of 5.2). The HUB reached these targeted sub-populations by building partnerships with organizations connected to them and by identifying CHWs with ties to them as well.

Table 1: Demographic characteristics of 757 clients who were referred to the Pathways HUB program in Toledo	
Variable	Frequency
Age (mean, std)	51.1 (14.8)
Number of Chronic Conditions (mean, std)	5.2 (3.4)
Gender (n, %)	
Male	257 (33.9)
Female	499 (65.9)
Transgender	1 (0.1)
Race (n, %)	
Black/African American	395 (52.2)
White	251 (33.2)
Other*	30 (4.0)
Missing	81 (10.7)
Highest Level of Education (n, %)	
Less than High School Graduate	211 (27.9)
High School Graduate	249 (32.9)
Some College	126 (16.6)
College Graduate	69 (9.1)
Don't Know	11 (1.5)
Missing	83 (11.0)
Refused	8 (1.1)
Average Annual Income (n, %)	
Less or Equal \$10,000	404 (53.4)
Between \$10,000 and \$25,000	264 (34.9)
More than \$25,000	36 (4.8)
Don't know/Missing/Refused/Unknown	53 (7.0)
Employment Status (n, %)	
Employed	139 (18.4)
Not Employed	529 (69.9)
Don't know	5 (0.7)
Missing	84 (11.1)
Prefer not to respond	2 (4.3%)

*American Indian or Alaskan Native, Arab/Chaldean White, Vietnamese White.

b) Identifying and reducing health risks

Client Pathways, as identified and assigned by CHWs, increased over the first two years of the program, reflecting the growing number of clients and risks being managed. Fifty-five participants in the first six months of operation were assigned a total of 232 Pathways. These Pathway assignments reflected identified sources of risk for the clients involved, a process resulting in determined mitigation steps for addressing and/or reducing these risks. The assigned Pathways included Medical Home, Health Insurance, Medical Referral, Housing, Education relevant to their condition and/or situation, Smoking Cessation, and referrals for a wide range of social services. More Pathways reflecting additional risks and increased client participation were subsequently added to the program through efforts to expand the available services for clients. This contributed to a total of 1,396 Pathway assignments after 18 months and 3,515 Pathway assignments after two years.

Opening Pathways for clients is a key step toward mitigating chronic disease risks, which are addressed and/or reduced by completing Pathways. Pathways are assigned to address identified risks to clients, and they include a range of factors present-

ing known health risks. For low-income adults, risk factors (and associated Pathways) include mental health issues,²¹ lack of health insurance coverage (Freeman et al, 2008),²² and a range of other established risks to health (see Table 2). Certified HUBs are required to use standardized Pathways in mitigating risks (through Pathway completion), and/or propose the development of new Pathways to the Pathways Community HUB Institute (PCHI), which certifies HUBs. For example, for a client with identified behavioral health issues, her/his Behavioral Health Pathway is considered complete if there is a confirmation that s/he has kept three scheduled appointments.¹

A Pathway may also be considered “finished incomplete” when the risk could not be completely addressed through the program. In these situations, it is the practice in the HUB model for CHWs or others to document the reasons a Pathway could not be completed. During the program’s early months, relatively high rates of “finished incomplete” discharges were experienced, with clients being discharged without completing all assigned Pathways. A large proportion of these discharges occurred because clients were “lost to follow up,” a finding identified during the formative evaluation efforts supported by the CDC grant. Analyses conducted during the course of the evaluation process revealed that personal contacts with clients tended to increase rates of Pathway completion,²⁰ and program managers subsequently took action to assure more regular CHW engagement with clients to support Pathway completion and risk reduction efforts.

The three most frequently used Pathways (Medical Referral, Education, and Social Services Referral) constituted 75% of all Pathways opened during the first two years of the HCNO program for low-income adults. Across these three Pathways, the average Pathway Mitigation Success rate (a measure of the rate of successful completion of Pathways that have been both assigned and closed) and Workload Production rate (a measure of the proportion of the HCNO HUB’s workload successfully completed, as of June 30, 2017) were 75.6% and 67.3%, respectively. These rates are slightly below the roughly 80% completion rates reported in previous work documenting Pathway completion rates for pregnant women.^{23,24} The three most frequently used Pathways were also completed relatively quickly, as they had a median duration of less than 10 days to completion as summarized in Table 2.

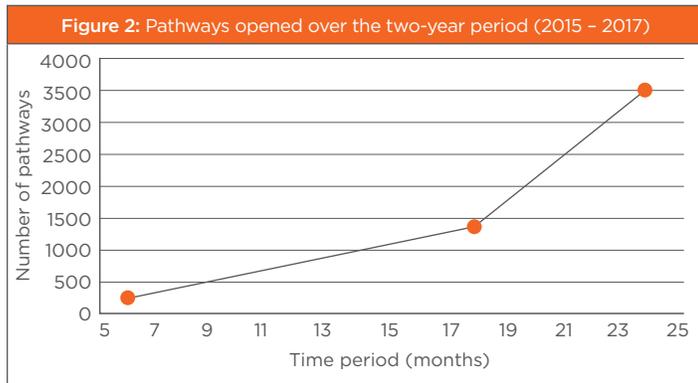
Table 2: Pathway completion rates and median duration times at 24 months				
Pathway	Total Pathways Assigned	Pathway Mitigation Success Rate (%)*	Workload Production Rate (%)**	Median Duration (days)
Most Frequent				
Education	366	94.6	90.7	1
Medical Referral	802	70.1	59.2	2
SSR Pathways	1,460	62.0	51.9	7
Overall	2,628	75.6	67.3	2
Less Frequent				
Medical Home	187	48.1	39.6	27
Health Insurance	152	40.0	32.9	18
Family Planning	10	30.0	30.0	25
Med. Assessment	153	36.8	27.5	2
Med. Management	15	25.0	20.0	6
Employment	50	16.2	12.0	117
Housing	167	21.1	11.4	83
Behavioral	19	12.5	10.5	33
Adult Education	63	9.6	7.9	36
Smoking Cessation	69	5.0	4.4	145
Overall	885	24.4	19.6	30

Note: Two Pathways (Lead and Immunization Referral), both with only one assignment each, were not included in the table.

***Pathway Mitigation Success Rate** = # of completed Pathways / (# of completed Pathways + # of Finished Incomplete Pathways)

****Workload Production Rate** = # of completed Pathways / (# of completed Pathways + # of Finished Incomplete Pathways + # of Pathways Opened but still pending)

Other Pathways that were less frequently assigned had completion rates of less than 50%. For example, the success rate for the Housing Pathway was below 25% and it typically took two months or more for clients to complete this Pathway. The limited availability of low-income housing in Lucas County made addressing this risk difficult. While services to meet the needs of adult clients were not always available, continuing relationship-building efforts by HUB managers did expand the availability of services, which seemed likely to contribute to improved Pathway completion rates as clients accessed these services. Figure 2 presents information on Pathways assigned over the first 2 years of the program, as well as an acceleration in Pathway assignments after 18 months. Overall, 651 clients, with assistance from CHWs, mitigated more than 1,770 identified risks by completing assigned Pathways by June 30, 2017.



c) Data management, evaluation, and continuous improvement

The HUB also faced challenges in managing information to coordinate services for clients, providing support payments for risk mitigations achieved, and enabling ongoing program improvements. Two challenges were particularly apparent: 1) a need to ensure that data were entered accurately and completely to track client progress and 2) a need to extract information.

During the early months, data entry problems were encountered, and data quality problems were identified by program evaluators hired through the CDC grant. Areas of concern included missing data, duplicate entries, and inconsistencies in entries across data fields linked to data entry practices and program and database design features. National certification standards for Pathways Community HUBs specify that CCAs are paid for verified actions taken to produce “completed Pathways,” thereby confirming that they have mitigated a specific risk identified for a client. They are not paid in full for “finished incomplete Pathways.” Furthermore, because the program had up-front funds to initiate services prior to developing an ability to bill payers for services, the HUB and its CCAs incorporated grant funded stipends for certain outcomes in the early years of the program. These payment features helped incentivize careful data entry. To further address data entry and quality issues identified after the initial training conducted during the summer of 2015, the HUB established ongoing training opportunities for those using the database and communicated needed design enhancements with the CCS vendor. Definitions of data elements were clarified and data quality improved, thus enabling confidence in the data used for the evaluation.

There were also challenges in extracting data from the database and in using it to inform program decision-making. Because the HUB and the national certification process are built on the ideals of care coordination and payments for risk mitigation, the CCS database was developed to track clients and their Pathways, coordinate services, and facilitate payments based on risk mitigations achieved. It was not developed to enable the compilation of relevant evaluative information, as was evident from the diverse reporting features in the database. With ongoing assistance from the database vendor and HUB staff, evaluators were able to

bring together information from multiple reporting formats in the database to enable usable data sets for evaluative purposes. Use of the CCS database is not required by national certification standards for the Pathways Community HUBs, but it is nevertheless our understanding that its vendor is taking steps to make it more conducive to program evaluation activity.

Program sustainability

The HUB took steps to address long-term program sustainability, and its program for adults with chronic illnesses remains operational as of this writing (in 2019). The Lucas County Pathways HUB became one of the first certified Pathway Community HUBs in the country with the establishment of the PCHI national certification program in 2014. As one of the nation’s early developing HUBs, its path toward sustainability may differ from those of other HUBs generally, which – according to the PCHI website – currently encounter certification costs of between about \$12,500 and \$31,000 to achieve PCHI certification.

After the Lucas County HUB’s certification, a CDC Partnerships to Improve Community Health (PICH) grant made it possible for the HUB to expand its services to include care coordination for adults with or at-risk of chronic disease. The CDC contributed approximately \$300,000 annually during the three years between 2014 and 2017 to enable the HUB to develop capacity and provide services for adults with or at-risk of chronic illness. This funding paid for staffing, operations, information systems, and evaluation related costs to expand the HUB’s services to adults with or at-risk of chronic illnesses. The CDC support was supplemented by additional funding from the Ohio Commission on Minority Health, which supported training CHWs and their initial employment. After the end of the CDC grant, the HUB sustained operations through contributions from other sources, including the Toledo Community Foundation, local hospitals such as Mercy, ProMedica, and the University of Toledo, and Lucas County Jobs and Family Services.

Additionally, in Ohio, MMC plans can make payments to support CHW services to Medicaid clients. In the second year of the Lucas County chronic illness program’s operation (2016-2017), HUB managers established contracts with three of Ohio’s five MMC plans to pay for the cost of CHW services through payments for enrollment and Pathway completion for adults with chronic disease risks. MMC outcome payments are playing a key role in enabling the program to sustain its services in Lucas County, but they are not sufficient to cover the costs of services for the program’s full client base. According to the HUB’s director, managed care payments for adult care coordination, on average, cover less than half of the employment costs for CHWs supporting the work of the Lucas County HUB. This is a lower proportion of cost recovery than what is achieved for health outcomes such as healthy birthweight babies and post-partum visits for at risk pregnant women enrolled in the HUB program for pregnant clients. In addition, CHW services (managed through the HUB) that are provided to adults with chronic illnesses who are not Medicaid eligible, or who are not enrolled in the MMC plans that contract with the HUB for outcome payments, are not reimbursed through the HUB.

DISCUSSION

The Pathways Community HUB model can be applied successfully to identify and mitigate risks for low-income adults with chronic illnesses. Over the course of two years, the Northwest Ohio Pathways HUB identified and sought to mitigate risks for 651 low-income individuals in the Lucas County, Ohio Pathways Community HUB program for adults with or at-risk of chronic disease. More than half of the Pathways assigned to these individuals to address risks were completed. The population served by this program is often highly mobile and may be homeless, so confirming that risks are addressed and/or reduced is inherently a challenge. As

a result, the Pathway completion figures presented in this article may not fully characterize the risk mitigations achieved. Nevertheless, these figures do suggest substantial efforts to identify, address, and reduce chronic disease impacts among low-income adults in Lucas County. Furthermore, the program's continuation attests to an ongoing capability to identify and mitigate chronic disease risks for low-income adults in Lucas County. These are not small accomplishments, nor were they easy to achieve.

HCNO's HUB managers faced multiple challenges. Managers had to develop community support to deliver and fund their services, and they had to establish ongoing capacities to coordinate care for the targeted audience. They also had to enroll and engage clients; assess their risks and enable assignment and completion of Pathways to mitigate risks; and use data systems to track care coordination progress, identify and guide service delivery improvements, and enable payments for CHWs based on their successful efforts to help clients mitigate their risk(s). To sustain the program, managers had to continue building relationships and identifying funding sources. Funding through Ohio MMC plans, and other organizations enabled continuation of the program beyond a federal CDC grant procured to develop and initiate it.

The Lucas County experience yields lessons for others seeking to develop and operate sustainable HUB programs serving low-income adults. Table 3 summarizes the challenges experienced by the program and management responses. It also identifies lessons learned from the development and operation of the chronic

disease HUB program for low-income adults during its first two years of operation. As the table indicates, during the planning stage, it is critical to develop community networks to support program services and funding. The HUB initially built community support from local organizations when the clinical-community linkages system was launched to serve low-income pregnant women. Subsequent to receiving a CDC grant, the HUB built partnerships with care coordination agencies to identify and serve low-income residents with or at-risk for chronic diseases, and trained CHWs to mitigate their risk(s) through data entry, tracking, and management processes that supported ongoing care coordination.

The program implementation phase also presented challenges, and steps taken by HCNO's HUB managers yield lessons for others. The HUB established key partnerships and enabled hiring of CHWs to reach its targeted clientele effectively. In addition, the program took advantage of standardized Pathways used in the certified Pathways Community HUB model and benefited from the client-tracking capabilities of systems used to support the model. Relatedly, the program worked to expand services for its clients in housing and other areas where sufficient services were not available and took conscious steps to deepen ongoing engagement with clients. To enable sufficient data quality, HUB managers found value in providing continuous training on data entry processes. In addition, while they found valuable support from a federal grant, HUB managers suggested tying payments to explicitly documented risk mitigation progress as early as

Table 3: HCNO HUB for Low-income Adults with Chronic Illnesses - Challenges, Responses, and Lessons for Others

Program Stage	Challenges	Lucas County Management Responses	Lessons for Others
Planning	<ul style="list-style-type: none"> Building community support to fund & deliver services. 	<ul style="list-style-type: none"> Built on existing service capabilities of the HUB Model to improve birth outcomes & reached out via informal networks. Issued a Request for Proposals (RFP). Sought local funding support. 	<ul style="list-style-type: none"> Use and develop community networks to support the effort with services & financial resources. Seek external funding to help attract local partners & to initiate & support risk identification and mitigation work.
	<ul style="list-style-type: none"> Establishing capacities to coordinate care – enroll participants, identify risks, & address/reduce risks through care coordination. 	<ul style="list-style-type: none"> Hired CHWs, with ties to targeted audiences. Trained CHWs to use existing Pathways tools, including database & Pathways certification resources. 	<ul style="list-style-type: none"> Build community support to develop capacity to identify and mitigate risks, and train and instruct CHWs on data entry & tracking processes to enable care coordination & risk mitigation.
Implementation	<ul style="list-style-type: none"> Enrolling & engaging clients 	<ul style="list-style-type: none"> Engaged partners with ties to the targeted audiences – CHWs, CCA's, & community partners. 	<ul style="list-style-type: none"> Establish community partnerships & take advantage of CHWs' community ties to reach & engage targeted client audiences.
	<ul style="list-style-type: none"> Identifying and reducing risks by assigning pathways and enabling their completion. 	<ul style="list-style-type: none"> Used standardized checklists to identify risks & assign pathways. Expanded pathways/services over time. Emphasized client engagement to build relationships for risk mitigation. 	<ul style="list-style-type: none"> Build on resources made available through the Pathways model & certification program. Continually work to expand local service availability Build relationships & regular communications with clients.
	<ul style="list-style-type: none"> Entering data & tracking progress. Extracting data to support program improvements. 	<ul style="list-style-type: none"> Up front & continuing training on data entry. Hired program evaluators to assess progress & define issues. Worked with evaluators, vendors, & staff to clarify data definitions & reporting formats. 	<ul style="list-style-type: none"> Train & re-train on data entry, management, & quality to support risk mitigation for clients. Tie payments to data entry and document progress ASAP, making sure that CHWs & CCA's understand processes & expectations. Engage evaluators to identify issues & suggest program improvements.
Program Sustainability	<ul style="list-style-type: none"> Sustaining the program over time 	<ul style="list-style-type: none"> Obtained a CDC grant to initiate the program & engage local supporters. Negotiated risk mitigation payments with Medicaid Managed Care payers. Solicited low cost/free support from local supporters. 	<ul style="list-style-type: none"> Plan for sustainability, seek external funding, & engage Medicaid payers to aid in mitigating risks.

possible. They also suggested working with external evaluators to provide ongoing feedback.

Another key lesson from the Lucas County experience relates to the value of planning for long-term sustainability. HCNO HUB leadership was aware that the CDC funding was temporary, so steps were taken from the beginning to maintain program sustainability after the grant ended in 2017. The HUB developed partnerships to build financial and programmatic capacities that did not depend on CDC grant funds and developed contracts with MMC plans. These efforts positioned the program to continue providing services and established an ongoing capacity to assist low-income adults with chronic illness in Lucas County.

While the HUB has provided care coordination to pregnant women since 2007, managers indicated that working with adults with chronic disease risks brought additional challenges. They suggested that reducing chronic disease risks for low-income adults should be recognized as a process that requires continuing engagements over long periods before it will achieve results. They also emphasized the importance of fully engaging with program clients and taking active steps to establish processes for ensuring data quality through entry, tracking, and management procedures. In addition, they suggested that efforts to train CHWs to ensure accurate data entry be emphasized, continually monitored, and improved to enable evaluations of program progress and suggestions for ongoing program improvements.

IMPLICATIONS FOR PUBLIC HEALTH

The experience of the Toledo Pathways Community HUB and the results reported above have implications for public health practice and policymakers in Ohio. For public health practitioners in Ohio communities, the information presented suggests that there are significant challenges to planning, implementing, and sustaining a Pathways Community HUB, and it defines and offers management strategies and lessons for public health practitioners seeking to address those challenges. It also suggests that successful efforts to address those challenges may yield beneficial results in the form of significant levels of risk mitigation for low-income adults with or at-risk of chronic illnesses in their communities.

This case study also has implications for policymakers. While Ohio has been innovative in expanding its Medicaid program and enabling MMC plans to support successful efforts to mitigate risk(s) through care coordination, this case study makes it clear that more can be done to identify and mitigate risks for low-income adults in Ohio. HCNO was able to develop its Pathways Community HUB program for low-income adults with or at-risk for chronic diseases because it built local support and obtained a CDC grant. To initiate additional efforts of this kind, the State of Ohio should consider establishing programs to provide financial support and strengthen community public health partnerships to enhance care coordination and mitigate chronic disease risks for low-income populations.

Ohio currently supports MMC payments for CHWs based on successful efforts to mitigate identified risk(s) (through the completion of Pathways, in the case of the Pathways Community HUB model) and it currently provides up-front funding for qualified community HUBs to address infant mortality. However, it is our understanding that not all MMC plans pay for documented risk mitigation for low-income adults with or at risk for chronic diseases, and those that do pay, do not appear to be paying the full cost. In addition, up-front funding payments from the state do not appear to capitalize the costs of establishing programs for low-income adults with chronic disease risks. Ohio may want to consider both providing funding to initiate care coordination programs for at-risk, low-income adults and requiring payments for documented risk mitigations across all five MMC plans for this audience. These changes in policy and practice would help enable

the expansion of service capabilities similar to those developed in Lucas County, while also providing funding to mitigate risk(s) for individuals whose care coordination costs are not currently covered by a MMC plan.

Finally, it is our understanding that MMC payments do not cover costs associated with program evaluation, through which HCNO's HUB recognized program implementation challenges and needed management responses. The State of Ohio may want to establish systematic funding for research and evaluation to support continuing improvements in care coordination services, including those relating to the Pathways Community HUB model. The initial work underlying this study was made possible through federal funding for evaluative studies. State funding for similar evaluative efforts would likely enable public health leaders and policy makers in Ohio to benefit from the ongoing generation of knowledge on challenges, management responses, and lessons learned from care coordination initiatives.

While this study and previous work^{1,2,24} suggest that the Pathways Community HUB model represents a promising approach for addressing health disparities, expanding healthcare access, and increasing the cost-effectiveness of healthcare services, further research relating to its use and impacts is warranted. More detailed and longer-term evaluations of existing programs for adults with chronic illnesses are also warranted, and more comprehensive assessments of Pathways Community HUB interventions would be helpful. A Risk Reduction Research Initiative (RRRI) has been established with the goal of guiding research to inform beneficial transformations in the health care and social service systems.²⁵ It also envisions further efforts to assess the extent to which specific identified risks and efforts to mitigate them actually result in positive health outcomes. More broadly, this initiative builds upon the risk-based focus of the Pathways Community HUB model and works to more comprehensively identify risks, evaluate the effects of risk mitigation, and assess the impacts of these risks and their mitigation on health and cost-related outcomes, both individually and in combination.

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