Adolescent Birth Rates and Rural–Urban Differences by Levels of Deprivation and Health Professional Shortage Areas in the United States, 2017–2018

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Objectives. To examine the differences in adolescent birth rates by deprivation and Health Professional Shortage Areas (HPSAs) in rural and urban counties of the United States in 2017 and 2018.

Methods. We analyzed available data on birth rates for females aged 15 to 19 years in the United States using the restricted-use natality files from the National Center for Health Statistics, American Community Survey 5-year population estimates, and the Area Health Resources Files.

Results. Rural counties had an additional 7.8 births per 1000 females aged 15 to 19 years (b = 7.84; 95% confidence interval [CI] = 7.13, 8.55) compared with urban counties. Counties with the highest deprivation had an additional 23.1 births per 1000 females aged 15 to 19 years (b = 23.12; 95% CI = 22.30, 23.93), compared with less deprived counties. Rural counties with whole shortage designation had an additional 8.3 births per 1000 females aged 15 to 19 years (b = 8.27; 95% CI = 6.86, 9.67) compared with their urban counterparts.

Conclusions. Rural communities across deprivation and HPSA categories showed disproportionately high adolescent birth rates. Future research should examine the extent to which contraceptive access differs among deprived and HPSA-designated rural communities and the impact of policies that may create barriers for rural communities. (*Am J Public Health*. 2021;111:136–144. https://doi.org/10.2105/AJPH.2020.305957)

Adolescent birth rates have steadily declined in the United States over the past 3 decades, reaching a record low of fewer than 18 births per 1000 females aged between 15 and 19 years in 2018.[1] Notable declines in adolescent birth rates have been observed across all racial and ethnic population groups.[1,2] While factors contributing to observed declines in adolescent birth rates are broad, recent evidence suggests that lower proportions of adolescents engaging in sexual intercourse coupled with more sexually active adolescents using some form of contraception, particularly long-acting reversible contraceptives, are 2 important factors.[3]

Although adolescent pregnancy and subsequent birth rates have declined, adolescent childbearing remains an important public health issue that warrants attention.[3] The vast majority of births among adolescents are unintended and introduce many socioeconomic and health-related challenges for adolescents relative to their peer groups.[3,4] The health consequences of adolescent childbearing range from adverse birth outcomes to psychological effects of childbearing for both the mother and the child.[4] While it is important to note that not all adolescent births are unintended, limited access to reproductive health services for adolescents and marginalized populations can cause these populations to have disproportionately high rates of unintended pregnancy.[5]

Previous research specifically focused on adolescent childbearing has consistently noted that unfavorable socioeconomic conditions experienced at the community and family levels underpin adolescent birth rates and observed racial/ethnic disparities.[6] Specifically, educational achievement, employment, and income have all been independently associated with adolescent births.[7] Similar patterns have been noted by geography as the rate of adolescent birth remains higher in rural communities relative to their urban counterparts.[8]

Higher rates of poverty and unemployment, shifting demographics, lower educational achievement, and lack of access to affordable health care and health care professionals are more prevalent in rural communities than in their urban counterparts.[9] Additional evidence suggests that in some rural or underresourced communities, fewer publicly funded clinics and health care professionals providing contraception are available,[10] and those rural adolescents may avoid reproductive health services over concerns of confidentiality. Further evidence suggests that receipt of sexual health education may be less common in rural communities.[11,12]

While previous research has noted the influence of social determinants of health on adolescent birth rates and noted rural–urban differences in rates of adolescent birth,[8,13] few studies have examined these factors in tandem. In this study, we examined the differences in adolescent birth rates by levels of sociodemographic deprivation based on a summary of social determinants of health measures and Health Professional Shortage Areas (HPSAs) in rural and urban counties of the United States, combining data from 2017 and 2018, the 2 most recent years of data available.

Deprivation indices and HPSA categories are increasingly common tools for examining the intersection of community context with health outcomes.[14] Key socioeconomic indicators that measure community-level deprivation are harmonized into a standard measure that characterizes key underlying social and economic constructs, rather than examining separate factors alone.[15] While it is common to observe higher levels of deprivation in rural communities,[13] recent studies have shown that urban communities can also have a similar or higher level of deprivation,[15,16] as well as a shortage of health care professionals.[17,18]

We hypothesized that our measures for rural–urban, area deprivation, and HPSA categories will be associated with adolescent birth rates. However, the extent to which rural–urban differences exist within comparable levels of deprivation and HPSA categories remains largely unknown. We posited that observed rural–urban differences would not be uniform across levels of deprivation and HPSA categories, with larger gaps observed in counties with higher levels of deprivation and HPSA categories.

METHODS

We conducted a cross-sectional study combining 2017 and 2018 county-level vital records data. County-level birth rates were derived from restricted-use natality files obtained from the National Center for Health Statistics linked with the American Community Survey 5-year population estimates from the Census Bureau. Additional county-level measures of interest, including the HPSA categories, were obtained from the Area Health Resources Files (AHRF). We analyzed data for all 3143 counties with available data on birth rates for females aged 15 to 19 years from all 50 states in the United States. Consistent with the Centers for Disease Control and Prevention,[1] we restricted the age group to females aged 15 to 19 years for reporting adolescent birth rates.

Measures

Adolescent birth rates. Consistent with previous research,[1,8,13] we identified adolescent birth rates as the ratio of pregnancies with live birth outcomes among females aged 15 to 19 years to the total population of females aged 15 to 19 years in each county per year. While studies have shown that the majority of adolescent births result from unintended pregnancies,[19–21] we are not attempting to quantify all adolescent unintended pregnancies for this analysis. Rather, we are focusing only on live births to adolescents.[1]

Rural–urban categories. Rural–urban categories were based on the 2013 Urban Influence Code (UIC) classification scheme by the Office of Management and Budget, which is consistent with previous county-level analysis.[14,15,22] The UIC distinguishes metropolitan and nonmetropolitan counties by population size or by proximity to metropolitan and nonmetropolitan areas.[23] Of the 12 UIC classifications, 2 subdivisions of the metropolitan areas with UICs of 1 (large—in a metro area with at least 1 million residents) and 2 (small—in a metro area with fewer than 1 million residents) formed the urban category, while 10 subdivisions of the nonmetropolitan areas (UICs 3–12) comprised the rural category.

Area deprivation index. The area deprivation index (ADI)[14,15] was constructed using county-level measures from the AHRF that reflect varying degrees of sociodemographic vulnerabilities within counties. Originally developed by researchers at the University of South Carolina, the ADI captures relevant county-level social determinants of health as a composite measure of county-level deprivation.[14] Five unique sociodemographic variables (income, poverty, unemployment, high-school graduation rate, and single-parent homes) were retained through a principal component analysis to characterize the underlying deprivation by counties. The retained variables were standardized into z scores, which were then summed together as a single measure used to derive the index. Counties were grouped into 4 categories using the quantile distribution of the deprivation index, which includes least deprived (quartile 1), not very deprived (quartile 2), somewhat deprived (quartile 3), and most deprived (quartile 4).[14,15]

Health Professional Shortage Area codes. As part of the AHRF, the HPSA codes identify county-level health care and health care workforce access for (1) primary care physicians, (2) dentists, and (3) mental health practitioners from the Health Resources and Services Administration database. The HPSA codes allocate designation status based on shortage areas. Counties that lack all 3 health care workforce groups are designated whole shortage areas and coded 1 on the AHRF. Where a proportion of a county has access to parts of the health care workforce, the county is a partly designated shortage area and coded 2. A county has a none designation and is coded 0 when it has all 3 health care workforce areas.[24]

Statistical Analysis

We examined the characteristics of counties by level of deprivation (least, not very, somewhat, and most deprived) and by HPSA categories (none, partly, and whole designated). We used the Student *t* test to examine differences in characteristics between rural and urban counties. We examined bivariate rural–urban differences in adolescent birth rates, bivariate relationships between adolescent birth rates and levels of deprivation, and the bivariate relationship between adolescent birth rates and HPSA categories.[8] We used 2 parallel adjusted linear regression models to examine the independent effect of deprivation, HPSA, and rural–urban classification on observed adolescent birth rates. Interaction terms for deprivation and rural–urban classification, as well as HPSA categories and rural–urban classification, were included in the separate models to assess potential rural–urban differences in adolescent birth rates within comparable levels of county deprivation and HPSA categories.

The adjusted models controlled for select variables of relevance (total population, race and ethnicity, non–English-speaking residents, and health care resources) that were not included in the ADI.[25,26] Also, we adjusted for the overall 5-year change in adolescent birth rates for each county to account for the changing trajectory of adolescent birth rates in each county. We obtained unadjusted and adjusted graphical plots of differences between rural and urban categories by levels of deprivation and HPSA categories from the least squares means of each model with a 95% confidence interval (CI). We considered the varying precision of estimated adolescent birth rates across counties by including a weight variable in the analysis, which was computed as the ratio of the sample population of females aged 15 to 19 years in each county to each county population. We conducted all data management and analyses with SAS version 9.4 (SAS Institute Inc, Cary, NC).

RESULTS

Approximately 62.9% of all counties in the United States were rural (Table 1). We observed significant differences in deprivation and HPSA categories between rural and urban counties. Of the rural counties in the United States, 19.6% were least deprived compared with 34.0% of urban counties, 23.5% were not very deprived compared with 27.6% of urban counties, 25.5% were somewhat deprived compared with 24.1% of urban counties, and 31.2% were most deprived compared with 14.3% of urban counties. Of the rural counties, 9.4% were HPSA none designated compared with 15.6% of urban counties, 59.4% were HPSA partly designated compared with 68.5% of urban counties, and 31.2% were HPSA whole designated compared with 15.9% of urban counties.

Key differences between rural and urban counties were noted for select covariates, including race and ethnicity. A higher proportion of adolescents in rural counties (43.1%) were enrolled in Medicaid compared with 36.6% in urban counties. Rural counties were associated with a lower primary care physician to population ratio (46.9%) compared with 60.6% for urban counties. The 5-year decline in adolescent birth rates was significantly slower in rural counties (–15.1%) compared with their urban counterparts (–24.4%).

TABLE 1— Characteristics of US Counties by Rural and Urban Categories: 2017–2018

County Characteristics	All Counties (n = 3143), Mean (95% CI)	Rural (n = 1976), Mean (95% CI)	Urban (n = 1167), Mean (95% CI)
ADI categories, %			
Least deprived**	24.97 (23.90, 26.04)	19.64 (18.4, 20.88)	33.98 (32.05, 35.90)
Not very deprived*	25.00 (23.93, 26.07)	23.45 (22.13, 24.77)	27.62 (25.8, 29.43)
Somewhat deprived[a]	25.00 (23.93, 26.07)	25.54 (24.18, 26.90)	24.09 (22.35, 25.83)
Most deprived**	25.03 (23.96, 26.10)	31.37 (29.92, 32.82)	14.32 (12.89, 15.74)
HPSA categories, %			
None designated**	11.71 (10.91, 12.50)	9.39 (8.48, 10.30)	15.62 (14.15, 17.10)
Parts designated**	62.77 (61.57, 63.96)	59.41 (57.87, 60.94)	68.45 (66.57, 70.34)
Whole designated**	25.52 (24.45, 26.60)	31.21 (29.76, 32.65)	15.93 (14.44, 17.41)
Population, females aged 15–19 y, %			
Total population**	6.25 (6.21, 6.29)	6.13 (6.07, 6.18)	6.46 (6.40, 6.51)
White**	83.23 (82.82, 83.65)	84.83 (84.29, 85.37)	80.54 (79.91, 81.17)
Black**	9.02 (8.66, 9.38)	7.84 (7.38, 8.31)	11.01 (10.46, 11.56)
Hispanic*	9.14 (8.80, 9.48)	8.76 (8.31, 9.20)	9.78 (9.26, 10.29)
Native Hawaiian/Pacific Islander*	0.08 (0.07, 0.09)	0.07 (0.06, 0.09)	0.10 (0.08, 0.12)
American Indian**	1.95 (1.76, 2.14)	2.54 (2.27, 2.82)	0.95 (0.75, 1.15)
Asian**	1.33 (1.26, 1.40)	0.71 (0.66, 0.77)	2.38 (2.23, 2.53)
Non–English-speaking residents**	3.41 (3.29, 3.53)	3.00 (2.85, 3.15)	4.09 (3.89, 4.29)
Health care resources			
Female < 18 y using Medicaid, %**	40.69 (40.33, 41.04)	43.09 (42.62, 43.55)	36.63 (36.13, 37.14)
Primary care physician per 100 000**	51.96 (51.07, 52.86)	46.87 (45.83, 47.92)	60.57 (58.98, 62.15)
Trend: 5-y change in adolescent birth rate, %**	−18.77 (−19.89, −17.65)	−15.18 (−16.89, −13.47)	−24.36 (−25.36, −23.36)

Noter. ADI = area deprivation index; CI = confidence interval; HPSA = Health Professional Shortage Area.

Source. Restricted-use natality files provided by the National Center for Health Statistics through the Centers for Disease Control and Prevention, American Community Survey 5-year population estimates provided by the Census Bureau, and the Area Health Resources Files.

*Difference between rural and urban categories is significant at $P < .05$; **$P < .001$.
[a]No difference between rural and urban categories.

Bivariate Associations With Adolescent Birth Rates

Table 2 examines the bivariate relationships between adolescent birth rates and each covariate of primary interest (rurality, county deprivation, and HPSA categories). We noted a significant differential adolescent birth rate by rurality and across levels of deprivation and HPSA categories.

Compared with the reference urban counterparts, adolescent birth rates in rural counties were markedly higher, contributing an additional 7.8 adolescent births per 1000 females aged 15 to 19 years (b = 7.84; 95% CI = 7.13, 8.55).

Higher adolescent birth rates were observed for higher levels of deprivation. When compared with the least deprived reference category, not very deprived counties had a higher adolescent birth rate (b = 6.70; 95% CI = 5.88, 7.51). On average, somewhat deprived counties had an additional 14.1 adolescent births per 1000 females aged 15 to 19 years (b = 14.10; 95% CI = 13.29, 14.91), while most deprived counties had an additional 23.1 adolescent births per 1000 females aged 15 to 19 years (b = 23.12; 95% CI = 22.30, 23.93).

Compared with counties in the none designated HPSA reference category, partly designated counties had significantly higher adolescent birth rates (b = 4.39; 95% CI = 3.28, 5.50). Counties that were whole HPSA designated also had significantly higher adolescent birth rate compared with the none designated reference category and the partly designated counties (b = 9.94; 95% CI = 8.69, 11.18).

TABLE 2— Bivariate Association Between Adolescent Birth Rates, Rurality, Deprivation, and Health Professional Shortage Area Categories: United States, 2017–2018

Categories	b (95% CI)*
Rurality	
Urban counties (Ref)	0
Rural counties	7.84 (7.13, 8.55)
Deprivation level	
Least deprived (Ref)	0
Not very deprived	6.70 (5.88, 7.51)
Somewhat deprived	14.10 (13.29 14.91)
Most deprived	23.12 (22.30, 23.93)
Health Professional Shortage Areas	
None designated (Ref)	0
Parts designated	4.39 (3.28, 5.50)
Whole designated	9.94 (8.69, 11.18)

Note. CI = confidence interval.

*Births per 1000 females aged 15 to 19 years.

Adjusted Analysis of Rural–Urban Differences

By levels of deprivation. Adjusted analysis examining rural–urban differences in adolescent birth rates within comparable levels of deprivation is shown in Table 3. The adjusted analysis explained about 50.7% of the total variance in the model (adjusted R^2 = 0.5066). On average, higher adolescent birth rates were noted for higher levels of deprivation, regardless of residence. However, the magnitude of adolescent birth rates across levels of deprivation was greater in rural counties than what was observed among their urban counterparts. When we compared it with the reference group of least deprived urban counties, we noted no statistically significant differences in adolescent birth rates among the least deprived rural counties (b = 0.54; 95% CI = –0.57, 1.65). However, we noted significant differences in adolescent birth rates for rural counties that were not very deprived when compared with urban counties that were least deprived (b = 6.05; 95% CI = 5.00, 7.11). Also, rural counties that were somewhat deprived had significantly higher adolescent birth rates compared with the reference category (b = 12.30; 95% CI = 11.18, 13.42). A significantly higher adolescent birth rate was noted among rural counties that were most deprived when compared with urban counties that were least deprived (b = 19.13; 95% CI = 17.79, 20.46).

Among urban counties that were not very deprived, the adolescent birth rate was higher than what was noted among urban counties that were least deprived (b = 5.29; 95% CI = 4.22, 6.37). Urban counties that were somewhat deprived had significantly higher adolescent birth rates than their least deprived counterparts (b = 10.45; 95% CI = 9.24, 11.65), but the rate was significantly below what was observed among rural counties that were somewhat deprived. The adolescent birth rate was significantly higher among urban counties that were most deprived (b = 15.65; 95% CI = 14.08, 17.22), when compared with their least deprived urban counterpart. Furthermore, adolescent birth rates in most deprived rural counties were significantly higher than in the most deprived urban counties.

Significant contributions of the select covariates were noted with the exception of the percentage of White and Black females aged 15 to 19 years. Notably, the county percentage of females aged 15 to 19 years (b = −1.36; 95% CI = −1.54, −1.18), Asian females aged 15 to 19 years (b = −0.53; 95% CI = −0.69, −0.36), and primary care physicians per 100 000 population (b = −0.04; 95% CI = −0.04, −0.03) were significantly associated with lower adolescent birth rate. However, percentage change in adolescent birth rate in the 5 years before 2018 (b = 0.05; 95% CI = 0.05, 0.06), percentage of Hispanic females aged 15 to 19 years (b = 0.10; 95% CI = 0.06, 0.14), percentage of American Indian females aged 15 to 19 years (b = 0.31; 95% CI = 0.23, 0.40), percentage of Hawaii/Pacific Islander females aged 15 to 19 years (b = 1.71; 95% CI = 1.03, 2.39), percentage of non–English-speaking individuals (b = 0.19; 95% CI = 0.07, 0.30), and the percentage of female adolescents aged younger than 18 years enrolled in Medicaid (b = 0.06; 95% CI = 0.03, 0.09) were all associated with higher adolescent birth rates.

By Health Professional Shortage Area categories. Table 3 shows the adjusted analysis for rural–urban differences in adolescent birth rates among comparable HPSA categories. The adjusted analysis explained about 32.6% of the total variance (adjusted R^2 = 0.326) in the model. Adolescent birth rates

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TABLE 3— Adjusted Rural–Urban Differences in Adolescent Birth Rates by Area Deprivation Index and Health Professional Shortage Area: United States, 2017–2018

Variable	b (95% CI)*
Model 1: ADI×rural–urban with covariates	
Least deprived/urban (Ref)	0
Not very deprived/urban	5.29 (4.22, 6.37)
Somewhat deprived/urban	10.45 (9.24, 11.65)
Most deprived/urban	15.65 (14.08, 17.22)
Least deprived/rural	0.54 (−0.57, 1.65)
Not very deprived/rural	6.05 (5, 7.11)
Somewhat deprived/rural	12.3 (11.18, 13.42)
Most deprived/rural	19.13 (17.79, 20.46)
Covariates, %	
5-y change in adolescent birth rate	0.05 (0.05, 0.06)
Females aged 15–19 y	−1.36 (−1.54, −1.18)
White females aged 15–19 y	0.03 (−0.05, 0.11)
Black females aged 15–19 y	0.04 (−0.03, 0.12)
Hispanic females aged 15–19 y	0.10 (0.06, 0.14)
Hawaii/Pacific Islander females aged 15–19 y	1.71 (1.03, 2.39)
American Indian females aged 15–19 y	0.31 (0.23, 0.40)
Asian females aged 15–19 y	−0.53 (−0.69, −0.36)
Non–English-speaking	0.19 (0.07, 0.3)
Females < 18 y in Medicaid	0.06 (0.03, 0.09)
Primary care physician per 100 000 population	−0.04 (−0.04, −0.03)
Model 2: HPSA×rural–urban with covariates	
None designated/urban (Ref)	0
Parts designated/urban	2.29 (0.98, 3.59)
Whole designated/urban	3.88 (2.19, 5.57)
None designated/rural	5.93 (4.23, 7.62)
Parts designated/rural	7.29 (6.00, 8.58)
Whole designated/rural	8.27 (6.86, 9.67)
Covariates, %	
5-y change in adolescent birth rate	0.05 (0.04, 0.06)
Females aged 15–19 y	−1.65 (−1.85, −1.44)
White females aged 15–19 y	−0.04 (−0.12, 0.05)
Black females aged 15–19 y	0.22 (0.13, 0.31)
Hispanic females aged 15–19 y	0.20 (0.15, 0.24)
Hawaii/Pacific Islander females aged 15–19 y	2.70 (1.92, 3.49)
American Indian females aged 15–19 y	0.41 (0.31, 0.51)
Asian females aged 15–19 y	−1.34 (−1.52, −1.16)
Non-English speaking	0.23 (0.10, 0.36)
Females < 18 y in Medicaid	NA
Primary care physician per 100 000 population	NA

Note. ADI = area deprivation index; CI = confidence interval; HPSA = Health Professional Shortage Area; NA = variable not included because HPSA already captures health care resources.

*Births per 1000 females aged 15 to 19 years.

were higher among rural counties within each HPSA designated category, on average. Among rural counties with whole shortage designation, adolescent birth rates were higher by an average of 8.3 births per 1000 females aged 15 to 19 years (b = 8.27; 95% CI = 6.86, 9.67), which is substantially higher when compared with the reference group of none designated urban counties. Compared with the reference group, partly designated rural counties had higher adolescent births (b = 7.29; 95% CI = 6.00, 8.58). Notably, none designated rural counties had higher adolescent birth rates when compared with the reference group of none designated urban counties (b = 5.93; 95% CI = 4.23, 7.62). Significant differences in adolescent births were noted among urban counties that were whole (b = 3.88; 95% CI = 2.19, 5.57) and partly (b = 2.29; 95% CI = 0.98, 3.59) designated, when compared with the reference group. However, adolescent birth rates in those urban counties were comparably lower than those of their rural counterparts.

Adolescent birth rates were significantly indirectly associated with the county percentage of females aged 15 to 19 years (b = −1.65; 95% CI = −1.85, −1.44) and percentage of Asian females aged 15 to 19 years (b = −1.34; 95% CI = −1.52, −1.16). However, percentage change in adolescent birth rate in the 5 years before 2018 (b = 0.05; 95% CI = 0.04, 0.06); percentages of females aged 15 to 19 years who were Black (b = 0.22; 95% CI = 0.13, 0.31), Hispanic (b = 0.20; 95% CI = 0.15, 0.24), American Indian (b = 0.41; 95% CI = 0.31, 0.51), and Hawaii/Pacific Islander (b = 2.70; 95% CI = 1.92, 3.49); and percentage of non–English-speaking individuals (b = 0.23; 95% CI = 0.10, 0.36) all

TABLE 4— Unadjusted and Adjusted Rural–Urban Predicted Means of the Adolescent Birth Rates by Levels of Deprivation and Health Professional Shortage Area Categories: United States, 2017–2018

Rural–Urban by ADI and HPSA	Rural (n = 1976)		Urban (n = 1167)	
	Unadjusted	Adjusted	Unadjusted	Adjusted
ADI categories				
Least deprived	16.43**	16.18[a]	11.51**	15.64[a]
Not very deprived	21.37*	21.69[a]	19.05*	20.93[a]
Somewhat deprived	29.01**	27.94*	25.66**	26.08*
Most deprived	37.74**	34.76**	33.33**	31.29**
HPSA categories				
None designated	23.88**	25.53**	15.82**	19.60**
Parts designated	26.98**	26.89**	20.13**	21.89**
Whole designated	31.36**	27.87**	24.60**	23.48**

Note. ADI = area deprivation index; HPSA = Health Professional Shortage Area.

*P < .05 for rural–urban pair; **P < .001 for rural–urban pair.

[a] Difference for rural–urban pair not significant.

were directly associated with higher adolescent birth rates.

Predicted Means of Rural–Urban Differences

Table 4 provides the predicted means of the adolescent birth rates derived from the unadjusted and adjusted models for both ADI and HPSA categories. We observed significant differences between rural and urban counties across all levels of deprivation in the unadjusted models. In the adjusted models, however, rural–urban differences in the rate of adolescent birth were attenuated among the least and not very deprived counties but remained significant among counties that are somewhat or most deprived.

In the unadjusted model for HPSA categories, higher adolescent birth rates were noted for both rural and urban counties as the county HPSA status changed from none to partly or whole designated shortage area. In the adjusted model, the difference in adolescent birth rates within the rural and urban counties across all the HPSA categories slightly leveled out, albeit with rural counties continuing to have significantly higher adolescent birth rates compared with urban counties.

DISCUSSION

In our study, we noted significantly higher adolescent birth rates as the level of county deprivation moved from lower to higher deprived categories for both rural and urban counties. Adolescent birth rates in rural communities were higher than what was observed among urban communities, which is consistent with recent findings on rural–urban differences in adolescent births.[8,17] While these 2 findings are important, our study also found that rural–urban differences in the rate of adolescent births persisted within comparable levels of deprivation, particularly among the most deprived counties. Importantly, the largest rural–urban differences in adolescent birth rates occurred among the most deprived counties. These findings suggest that higher levels of county deprivation may have more of an impact on adolescent births in rural communities than what is observed among their urban counterparts.

Furthermore, our study showed significantly higher adolescent birth rates by HPSA designation status among rural counties compared with urban counties. While these findings reveal the unique characteristics of the HPSA status as a useful social determinant of adolescent birth, we believe that rural communities have inherent vulnerabilities that contribute to poorer health outcomes including high adolescent birth rates.[15,16] For example, multilevel social and environmental factors such as census divisions, socioeconomic status, household sizes, minority language, and less access to health care facilities were shown to positively influence poor health outcomes including adolescent births.[15,16,27]

In addition to access to care in physician practices, the availability of contraceptive services through other safety net providers is also important. Our study shows that each additional primary care physician reduced adolescent birth rates by 0.04 births per 100 000 population. Previous research suggests that adequate contraceptive access in vulnerable communities will likely reduce adolescent births.[25,28,29] The Title X program, administered by the Office of Population Affairs within the US Department of Health and Human Services,[30,31] has had meaningful impacts on reducing adolescent births through the provision of contraceptives including long-acting reversible contraceptives.[32] However, there remain enormous challenges around contraceptive access[33] exacerbated by the recent domestic gag rule that puts further restrictions on Title X grantees.[34] Our findings show that residents living in deprived and medically underserved rural communities are more likely to be affected by these challenges. The Performance Measure Learning Collaborative could improve contraceptive access in vulnerable rural and urban communities.[35] This collaborative facilitates quality contraceptive care through clinical performance measures and a hybrid of effective best practices for Title X grantees. Health care infrastructures such as private insurance networks and federally qualified health centers could better expand access to contraceptive care using performance measures through collaborative learning.[35] Also, provision of contraceptive care through telehealth could bridge the accessibility gap and facilitate patient-centered contraceptive services, leading to improved wellness in deprived rural communities.[5]

Limitations

This study is not without limitations. The causes of rural–urban differences in adolescent birth rates over time were not examined in this study. As such, definitive causes of rural–urban differences in adolescent birth rates remain to be established.[17] As shown by the goodness-of-fit R^2 statistics for the adjusted models, it is evident that there are other sources of variation that are currently unaccounted for by our models. Also, we did not consider state-level health care access, such as Medicaid expansion, in the current study. In the future, we will expand our current models by examining the longitudinal differences in the level of impact of national policies on adolescent birth rates, unintended pregnancies, and repeat births in both rural and urban counties of the United States.

Public Health Implications

Our study provides additional evidence on rural disparities in terms of deprivation and structural barriers such as HPSAs. Notably, our findings emphasize that living in rural communities that often have disparate socioeconomic, demographic, and structural vulnerabilities is associated with higher adolescent birth rates compared with urban communities. Our study contributes to the body of evidence on the impact of adequate health care resources in reducing adolescent births in rural communities with underlying socioeconomic and structural vulnerability.[16,25,28,29]

Notably, each additional primary care physician reduced adolescent birth rates by 0.04 births per 100 000 population. Although not completely sufficient, availability and access to primary care physicians could be crucial to effective contraceptive counseling and follow-up procedures, particularly in the most deprived rural communities.[18] Furthermore, there is the need to address structural and financial barriers, which could improve women's health outcomes and reduce adolescent birth rates especially in deprived rural communities. AJPH

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CONTRIBUTORS

S. O. Orimaye conducted the data analyses, wrote the original article, and managed the revisions and responses to reviewers. N. Hale and A. Khoury conceptualized and designed the study and contributed to writing and editing the article. E. Leinaar performed data curation and management and contributed to writing and editing the article. M. G. Smith contributed to the design and management of the study and to writing and editing the article. All authors contributed to the critical review of the study.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

HUMAN PARTICIPANT PROTECTION

This study reports results from the analysis of de-identified, publicly released data and is exempt from institutional review board review as per section 46.101(b) of National Institutes of Health document 45 CFR 46.

REFERENCES

1. Martin JA, Hamilton BE, Osterman MJK, Driscoll AK. Births: final data for 2018. *Natl Vital Stat Rep*. 2019; 68(13):1–47.
2. Kearney MS, Levine PB. Teen births are falling: what's going on? The Brookings Institution. 2014. Available at: https://www.brookings.edu/wp-content/uploads/2016/06/teen_births_falling_whats_going_on_kearney_levine.pdf. Accessed October 21, 2020.
3. Abma JC, Martinez GM. Sexual activity and contraceptive use among teenagers in the United States, 2011–2015. *Natl Health Stat Report*. 2017; (104):1–23.
4. Diedrich JT, Klein DA, Peipert JF. Long-acting reversible contraception in adolescents: a systematic review and meta-analysis. *Am J Obstet Gynecol*. 2017;216(4):364.e1–364.e12. https://doi.org/10.1016/j.ajog.2016.12.024
5. Sundstrom B, DeMaria AL, Ferrara M, Meier S, Billings D. "The closer, the better:" the role of telehealth in increasing contraceptive access

among women in rural South Carolina. *Matern Child Health J*. 2019;23(9):1196–1205. https://doi.org/10.1007/s10995-019-02750-3

6. Penman-Aguilar A, Carter M, Snead MC, Kourtis AP. Socioeconomic disadvantage as a social determinant of teen childbearing in the US. *Public Health Rep*. 2017;128(suppl 1):5–22. https://doi.org/10.1177/00333549131282s102
7. Decker MJ, Isquick S, Tilley L, et al. Neighborhoods matter. A systematic review of neighborhood characteristics and adolescent reproductive health outcomes. *Health Place*. 2018;54:178–190. https://doi.org/10.1016/j.healthplace.2018.09.001
8. Hamilton BE, Rossen LM, Branum AM. Teen birth rates for urban and rural areas in the United States, 2007–2015. *NCHS Data Brief*. 2016;(264):1–8.
9. Crosby RA, Wendel ML, Vanderpool RC, Casey BR. *Rural Populations and Health: Determinants, Disparities, and Solutions*. San Francisco, CA: John Wiley & Sons; 2012.
10. Singh GK, Siahpush M. Widening rural–urban disparities in life expectancy, US, 1969–2009. *Am J Prev Med*. 2014;46(2):e19–e29. https://doi.org/10.1016/j.amepre.2013.10.017
11. Martins SL, Starr KA, Hellerstedt WL, Gilliam ML. Differences in family planning services by rural–urban geography: survey of Title X–supported clinics in Great Plains and Midwestern states. *Perspect Sex Reprod Health*. 2016;48(1):9–16. https://doi.org/10.1363/48e7116
12. Lindberg LD, Maddow-Zimet I, Boonstra H. Changes in adolescents' receipt of sex education, 2006–2013. *J Adolesc Health*. 2016;58(6):621–627. https://doi.org/10.1016/j.jadohealth.2016.02.004
13. Daniels K, Martinez GM, Nugent CN. Urban and rural variation in fertility-related behavior among US women, 2011–2015. *NCHS Data Brief*. 2017;(297):1–8.
14. Hale N, Probst J, Robertson A. Rural area deprivation and hospitalizations among children for ambulatory care sensitive conditions. *J Community Health*. 2016;41(3):451–460. https://doi.org/10.1007/s10900-015-0113-2
15. Hale N, Beatty K, Smith M. The intersection of residence, community vulnerability, and premature mortality. *J Rural Health*. 2019;35(4):471–479. https://doi.org/10.1111/jrh.12318
16. Yee CW, Cunningham SD, Ickovics JR. Application of the Social Vulnerability Index for identifying teen pregnancy intervention need in the United States. *Matern Child Health J*. 2019;23(11):1516–1524. https://doi.org/10.1007/s10995-019-02792-7
17. Sutton A, Lichter DT, Sassler S. Rural–urban disparities in pregnancy intentions, births, and abortions among US adolescent and young women, 1995–2017. *Am J Public Health*. 2019;109(12):1762–1769. https://doi.org/10.2105/AJPH.2019.305318
18. Fields BE, Bigbee JL, Bell JF. Associations of provider-to-population ratios and population health by county-level rurality. *J Rural Health*. 2016;32(3):235–244. https://doi.org/10.1111/jrh.12143
19. Gavin L, Frederiksen B, Robbins C, Pazol K, Moskosky S. New clinical performance measures for contraceptive care: their importance to healthcare quality. *Contraception*. 2017;96(3):149–157. https://doi.org/10.1016/j.contraception.2017.05.013
20. Potter JE, Stevenson AJ, Coleman-Minahan K, et al. Challenging unintended pregnancy as an indicator of reproductive autonomy. *Contraception*. 2019;100(1):1–4. https://doi.org/10.1016/j.contraception.2019.02.005
21. Kost K, Zolna M. Challenging unintended pregnancy as an indicator of reproductive autonomy: a response. *Contraception*. 2019;100(1):5–9. https://doi.org/10.1016/j.contraception.2019.04.010
22. Shoff C, Yang T-C. Spatially varying predictors of teenage birth rates among counties in the United States. *Demogr Res*. 2012;27(14):377–418. https://doi.org/10.4054/DemRes.2012.27.14
23. Cromartie J. *Rural America at a glance 2018 edition*. US Department of Agriculture. 2018. Available at: http://ageconsearch.umn.edu/record/282512/files/EIB200.pdf. Accessed April 24, 2020.
24. Health Resources and Services Administration. User documentation for the county Area Health Resources File (AHRF), 2018–2019. 2019. Available at: https://data.hrsa.gov/topics/health-workforce/ahrf. Accessed January 8, 2020.
25. Lindo JM, Packham A. How much can expanding access to long-acting reversible contraceptives reduce teen birth rates? *Am Econ J Econ Policy*. 2017;9(3):348–376. https://doi.org/10.1257/pol.20160039
26. Kraft JM, Kulkarni A, Hsia J, Jamieson DJ, Warner L. Sex education and adolescent sexual behavior: do community characteristics matter? *Contraception*. 2012;86(3):276–280. https://doi.org/10.1016/j.contraception.2012.01.004
27. Simpson KR. Ongoing crisis in lack of maternity services in rural America. *MCN Am J Matern Child Nurs*. 2020;45(2):132. https://doi.org/10.1097/NMC.0000000000000605
28. Andrews B, Ross C, Yoost JL. Availability of long acting reversible contraceptives for adolescents in urban vs rural West Virginia counties. *Marshall J Med*. 2019;5(3):20–29. https://doi.org/10.33470/2379-9536.1228
29. Steenland MW, Pace LE, Sinaiko AD, Cohen JL. Association between South Carolina Medicaid's change in payment for immediate postpartum long-acting reversible contraception and birth intervals. *JAMA*. 2019;322(1):76–78. https://doi.org/10.1001/jama.2019.6854
30. Frost JJ, Frohwirth L, Zolna MR. Contraceptive needs and services, 2014 update. Guttmacher Institute. 2016. Available at: https://www.guttmacher.org/report/contraceptive-needs-and-services-2014-update. Accessed April 24, 2020.
31. Ranji U, Salganicoff A, Sobel L, Rosenzweig C, Gomez I. Financing family planning services for low-income women: the role of public programs. The Henry J. Kaiser Family Foundation. 2017. Available at: http://files.kff.org/attachment/Issue-Brief-Financing-Family-Planning-Services-for-Low-income-Women. Accessed April 24, 2020.
32. Frost JJ, Frohwirth LF, Blades N, Zolna MR, Douglas-Hall A, Bearak J. Publicly funded contraceptive services at US clinics, 2015. Guttmacher Institute. 2017. Available at: https://www.guttmacher.org/report/publicly-funded-contraceptive-services-us-clinics-2015. Accessed April 24, 2020.
33. Kumar N, Brown JD. Access barriers to long-acting reversible contraceptives for adolescents. *J Adolesc Health*. 2016;59(3):248–253. https://doi.org/10.1016/j.jadohealth.2016.03.039
34. Mahase E. US abortion gag: clinics that leave family planning programme may have to destroy contraceptives. *BMJ*. 2019;366:l4969. https://doi.org/10.1136/bmj.l4969
35. Loyola Briceno AC, Kawatu J, Saul K, et al. From theory to application: using performance measures for contraceptive care in the Title X family planning program. *Contraception*. 2017;96(3):166–174. https://doi.org/10.1016/j.contraception.2017.06.009