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Impact of social service and public health spending on teenage birth rates across the USA: an ecological study

Heather L Sipsma,[1,2] Maureen Canavan,[1] Melissa Gilliam,[2] Elizabeth Bradley[1]

ABSTRACT

Objective To examine whether greater state-level spending on social and public health services such as income, education and public safety is associated with lower rates of teenage births in USA.

Design Ecological study.

Setting USA.

Participants 50 states.

Primary outcome measure Our primary outcome measure was teenage birth rates. For analyses, we constructed marginal models using repeated measures to test the effect of social spending on teenage birth rates, accounting for several potential confounders.

Results The unadjusted and adjusted models across all years demonstrated significant effects of spending and suggested that higher spending rates were associated with lower rates of teenage birth, with effects slightly diminishing with each increase in spending (linear effect: B=−0.20; 95% CI −0.31 to 0.08; p<0.001 and quadratic effect: B=0.003; 95% CI 0.002 to 0.005; p<0.001).

Conclusion Higher state spending on social and public health services is associated with lower rates of teenage births. As states seek ways to limit healthcare costs associated with teenage birth rates, our findings suggest that protecting existing social service investments will be critical.

Strengths and limitations of this study

► Previous research has not explored the association between state-level spending on social and public health services and teenage birth rates.

► Despite the use of lagged effects, our analysis cannot establish temporality with these data.

► Although our state-level analysis should not be used to make inferences about relationships at an individual level, our findings may inform state-level spending choices for policy makers and practitioners.

► We were unable to detect which services were most strongly associated with teenage birth rates, as spending on different services was highly correlated in these observational data.

[1]Department of Health Policy and Management, Yale School of Public Health, New Haven, Connecticut, USA
[2]Center for Interdisciplinary Inquiry and Innovation in Sexual and Reproductive Health, University of Chicago, Chicago, Illinois, USA

Correspondence to
Dr Heather L Sipsma;
hsipsma@ben.edu

INTRODUCTION

Despite substantial declines over the last two decades, USA continues to have the highest teenage birth rate of any industrialised country.[1] Annually, more than 270 000 babies are born to young women between 15 and 19 years of age,[2] and rates vary widely across states from 13 births to 48 births per 1000 women ages 15–19. Teenage births have a tremendous effect on the lives of parents and children. Teenage mothers and fathers tend to have more limited educational attainment and economic opportunities and less marital stability than their peers who delay childbearing.[3] Teenage parenthood, thus, tends to preserve disadvantaged contexts and perpetuates intergenerational cycles of young childbearing.[4 5]

Previous studies have found that contextual factors—such as poverty,[6] income inequality,[7] unemployment[8] and social capital[9]—have been associated with teenage birth rates. Their effects, however, were modest and together leave much of the variation unexplained. Only one previous study has examined the influence of state spending on teenage pregnancy. This study showed that lower social welfare benefits are associated with higher teenage birth rates.[8] Previous research has not examined the association between state-level spending on a broader set of social services (eg, education, housing, income and nutritional support) and teenage birth rates.

Social service and public health spending might affect teenage birth rates in several ways. First, spending on education may result in better quality school systems, greater student engagement and thus increased economic opportunities.[10 11] Additionally, more after-school and summer programming for youth might result in greater adult monitoring and mentoring.[12 13] These opportunities may translate to greater responsibilities among youth and less idle time. Second, social spending on housing may enhance residential stability, allowing families to be less fragmented and to build and capitalise on stronger social support and social capital.[14 15] Third, spending on the environment or recreation and on public

safety may provide additional safe spaces for community engagement. Fourth, social spending may provide lower income individuals with financial assistance, potentially improving psychosocial health and development,[16] [17] thereby reducing adolescent engagement in sexual risk behaviours.[18] [19] Last, spending on transportation services and community healthcare programmes may result in less infrastructure inequality and thus improved access to healthcare and family planning services.[20] This hypothesis aligns well with previous research suggesting that the decrease in teenage birth rates since the early 1990s has been partly attributed to reduced rates of sexual activity and increased use of contraception.[8] [21]

Accordingly, we sought to examine whether states with higher social service spending have lower rates of teenage births across USA. Because such spending supports a variety of services that may mitigate an individual's risk of birth as a teenager, we hypothesised that states that spend more in areas such as income support, housing, education and nutritional assistance will have lower teenage birth rates. As no single database collects these contextual factors simultaneously, we combined a number of relevant databases. We used the most recent healthcare spending data from the National Health Expenditures Data (based on Centers for Medicare & Medicaid data) and public health and social service spending data from the US Census Bureau for years 2005 through 2009. We used teenage birth rates from the Kaiser Family Foundation. This state-level analysis may provide insight into the variation in teenage birth rates across states and inform efforts by policy makers, healthcare providers and researchers to leverage both public health and social service spending to support a continued decline in teenage birth rates.

METHODS
Study design
We conducted an ecological study by constructing a dataset that included teenage birth rates and spending on social and public health services among the 50 states in USA. Spending data were limited to years 2005 through 2009, the most recent 5-year period (n=250) for which consistent data were available. Because the study uses publicly available, deidentified data, it was deemed exempt from review by the Institutional Review Board at Yale University School of Medicine.

Measures
Dependent variable
Our outcome was teenage birth rates per 1000 women between 15 and 19 years of age. These data were abstracted from the Kaiser Family Foundation at http://kff.org/other/state-indicator/teen-birth-rate-per-1000/ for each state for the years 2007 through 2011 to investigate 2-year lagged effects.

Independent variable
We calculated the total social service and public health spending per population of individuals living below the

federal poverty level, as the target of social spending tends to be low-income people. Social services included primary, secondary and higher education; income supports (eg, cash assistance, general relief for low-income or needs-tests beneficiaries of public welfare programmes); transportation (eg, airports, waterways, vessels, public mass transit systems); environment (eg, sanitation and recreational programming, conservation of natural resources); public safety (eg, law enforcement and fire protection) and housing (eg, aid for public or private housing and community development). These data were obtained from the US Census Bureau Annual Survey of State and Local Government Finances (US Census Bureau, 2014), the Social Security Administration, Administration for Children and Families and the US Department of Agriculture. Public health spending included expenditures for public health department activities, such as disease surveillance, Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), community healthcare programmes, regulation of air and water quality and animal control. These spending data were obtained from the US Census Bureau.

Covariates
Covariates were selected based on their associations with teenage birth rates in previous literature,[4] [5] [7] [8] and included several demographic and economic factors for each state. We gathered data from the US Census Bureau on the percent of the population under 18 years old, per cent female, per cent non-Hispanic White, per cent non-Hispanic Black, per cent Hispanic, per cent of adults aged 25 years or older with a high school diploma, per cent of population living in urban area and geographical region. We gathered data on unemployment rates from the US Department of Labor and the per cent of children living in single-parent household from National KIDS COUNT (http://datacenter.kidscount.org). State-level gross domestic product (GDP) per capita was obtained from the US Department of Commerce and Bureau of Economic Analysis, and Medicaid expenditure data were extracted from the National Health Expenditure Account data files maintained by Centers for Medicare and Medicaid Services.

Statistical analysis
We first generated means and SD by state to describe variation across states for the year 2009. We then plotted the 2009 spending rate against the 2011 teenage birth rate to visualise this association; based on this plot, we hypothesised the existence of both linear and quadratic effects of spending. We then constructed an unadjusted marginal model using repeated measures to test the linear and quadratic effects of spending on teenage birth rates. The model specified a year fixed effect and took into account the non-independence of observations for each state across years by specifying repeated years within states, allowing for correlated residual error terms. We then

extended this model by including covariates to adjust for potential confounders. All models used 2-year lagged spending rates in order to account for proposed time lag between effect of social spending and a subsequent birth. We also tested whether state-level GDP moderates associations between spending and teenage birth by including an interaction term between GDP (high vs low) and spending. Spending rate was centred at its mean to reduce correlation between variables for all models. There were no missing data.

We explored two potential modifications to our final model. First, we gathered data on the Gini index of income inequality from the American Community Survey (ACS); however, this variable was only available for the years 2006–2009. We also calculated abortion rates per female population ages 15–19 in each state by first abstracting the number of abortions reported by state from the ACS and then dividing this number by state-level population estimates from the US Census Bureau for the years 2005 through 2009. These data, however, were unavailable for several states across the years. We explored their effects by including these variables in our final model among their respective subsets of available data. All analyses were performed with SPSS V.21.0 (Chicago, Illinois, USA).

RESULTS

State descriptive statistics

Table 1 displays means and SD of state-level teenage birth rates, social service and public health spending per individual living in poverty and covariates for the year 2009. On average, the teenage birth rate was 37.7 per 1000 female population ages 15–19 in 2009; this rate dropped to 31.3 births per 1000 population ages 15–19 in 2011. On average, the social spending rate was approximately US$59 960 per individual living in poverty.

Association between teenage birth rates and spending, using lagged effects

The scatter plot of the association between teenage birth in 2011 and spending rates in 2009 is shown in figure 1. The unadjusted model across all years suggested that including both linear and quadratic effects of spending fit the data better than including only a linear effect of spending. Results revealed significant effects of spending. Higher spending rates were associated with lower rates of teenage birth; however, these effects diminished slightly with increases in spending (linear effect: B=−0.61; 95% CI −0.66 to −0.56; $p<0.001$ and quadratic effect: B=0.01; 95% CI 0.01 to 0.01; $p<0.001$).

Results of the adjusted model are shown in table 2. Accounting for all covariates attenuated the unadjusted associations in the overall sample. The marginal model suggests that there exists both linear and quadratic effects, such that every US$1000 increase in the social spending rate was associated with decreases in the teenage birth rates overall, with effects slightly diminishing with increasing social spending (linear effect: B=−0.20; 95%

Table 1 State-level descriptive statistics, 2009 (n=50)

|	Mean (SD)
% Under 18	24.0 (1.88)
% Female	50.7 (0.73)
% Non-Hispanic White	80.9 (12.38)
% Non-Hispanic Black	10.6 (9.62)
% Hispanic	10.4 (9.91)
% Children living in single-parent home	32.6 (5.25)
% Individuals with a high school diploma	86.9 (3.41)
Unemployment rate	8.4 (1.96)
% Individuals living below poverty	13.8 (3.07)
% Urban	71.7 (14.90)
log(GDP/capita)	2.5 (0.17)
Medicaid (US$100 000)	68.8 (88.38)
Region (n (%))	
New England	30 (12.0)
Mideast	25 (10.0)
Great Lakes	25 (10.0)
Plains	35 (14.0)
Southeast	60 (24.0)
Southwest	20 (8.0)
Rocky Mountain	25 (10.0)
Far West	30 (12.0)
Social spending* (US$1000)	60.0 (20.70)
Teenage birth rate in 2009[†]	37.7 (11.47)
Teenage birth rate in 2011[†]	31.3 (9.64)

*Social spending=(Social service spending+public health spending)/individuals living in poverty.
†Per 1000 population ages 15–19.
GDP, gross domestic product.

CI −0.31 to −0.08; $p<0.001$ and quadratic effect: B=0.003; 95% CI 0.002 to 0.005; $p<0.001$). Estimates were slightly higher in magnitude and remained statistically significant when excluding outlying states (Arkansas, Wyoming). Subsequent analyses demonstrated consistent effects on teenage birth rates when using spending variables lagged by 1 year (linear effect: B=−0.23; 95% CI −0.35 to −0.12; $p<0.001$ and quadratic effect: B=0.004; 95% CI 0.002 to 0.005; $p<0.001$) and by 3 years (linear effect: B=−0.16; 95% CI −0.28 to −0.05; $p<0.001$ and quadratic effect: B=0.003; 95% CI 0.002 to 0.005; $p<0.001$). Additionally, we found no evidence that state-level GDP moderates associations between spending and teenage birth rates, as neither of the interaction terms testing this association was statistically significant ($p>0.3$).

Inclusion of the Gini index of income inequality did not meaningfully change the parameter estimates for the linear or quadratic effect of the social spending rate (linear effect: B=−0.18; 95% CI −0.30 to −0.06; $p=0.004$ and quadratic effect: B=0.003; 95% CI 0.002 to 0.005; $p<0.001$) and was not statistically significant in the
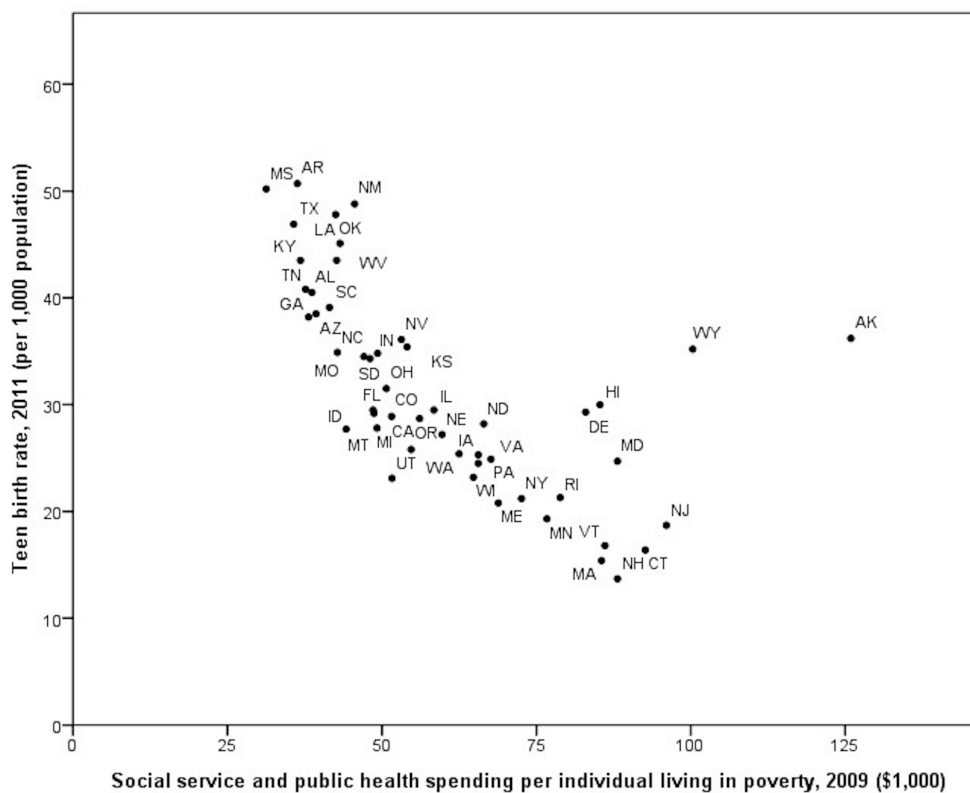
Figure 1 Association between 2009 social spending rates and 2011 teenage birth rates in USA.

model. When teenage abortion rates were included in the final multivariable model (n=223), they were also not significantly associated with teenage birth rates (B=0.09; 95% CI −0.04 to 0.22; p=0.183); however, the inclusion of teenage abortion rates strengthened the associations between spending and teenage birth rates (linear effect: B=−0.34; 95% CI −0.45 to −0.22; p<0.001 and quadratic effect: B=0.005; 95% CI 0.003 to 0.006; p<0.001). Abortion rates, thus, appeared to be a negative confounder of this relationship between social spending and teenage birth rates.

DISCUSSION

Our results indicate that between 2005 and 2009, states with higher spending on social services had lower rates of teenage births, even when accounting for commonly identified risk factors. These covariates explained part of the magnitude of the effect seen in our unadjusted analysis, but the reduced effect remained statistically significant in our adjusted models. Every US$1000 increase in the social spending rate was associated with a decrease of approximately 1% (0.64%–1.44%) of the average teen birth rate in 2011 (31.3 per 1000 females 15–19 years of age).[2] These results, which focus on multiple spending components, extend previous findings that focus on public policies.[8] Although we cannot establish causality with these observational data, the use of lagged effects and the robust and consistent associations are noteworthy.

Our findings should be interpreted in light of some limitations. First, the analysis is a state-level analysis and

should not be used to make inference about causal relationships at an individual level. Nevertheless, as the goal was to provide exploratory data to policy makers and practitioners about state-level spending choices, the patterns of association are notable. Second, our analysis was limited to 5 years of data, and although we were able to model the effect of previous spending on subsequent teenage birth rates, we were prevented from looking at longer-term effects. Additionally, this association was found using data from the years 2005–2009 and thus, may not be generalisable to current patterns in teenage birth rates. Our analysis was also limited by data availability. For instance, we had limited access to abortion rates for females ages 15–19 and the Gini index. Furthermore, we were unable to ascertain birth rates per state by poverty level, which may be particularly important, because our spending measure is per person living in poverty. These data would have allowed us to determine whether or not the effects of spending were stronger among those living below the poverty line compared with those living above the poverty line. Despite this, we believe our findings add importantly to the literature on social determinants, which indicates that social determinants of health can affect whole communities rather than particular segments of communities. Last, we were unable to detect which social services were most strongly associated with teenage birth rates, as spending on different services were highly correlated in these observational data. Although understanding the effects of specific programmes may be possible with controlled interventional studies, our

Table 2 Marginal models examining the effect of social service and public health spending per individual living in poverty on teenage birth rates, adjusted for state characteristics

	B (95% CI)			
	Overall sample (n=250)		Sample without AK and WY (n=240)	
	Unadjusted	Adjusted	Unadjusted	Adjusted
Social spending rate†				
Linear effect	−0.61 (−0.66 to −0.56)**	−0.20 (−0.31 to −0.08)**	−0.65 (−0.70 to −0.61)**	−0.45 (−0.57 to −0.33)**
Quadratic effect	0.01 (0.01 to 0.01)*	0.003 (0.002 to 0.005)**	0.01 (0.01 to 0.01)*	0.007 (0.005 to 0.009)**
% Under 18	2.58 (1.84 to 3.33)**	0.68 (0.25 to 1.10)**	2.65 (1.87 to 3.42)**	0.52 (0.11 to −0.93)*
% Female	−1.32 (−3.29 to 0.65)	−1.35 (−3.10 to 0.39)	−0.85 (−3.34 to 1.64)	0.09 (−1.69 to 1.87)
% Non-Hispanic White	−0.23 (−0.35 to −0.12)**	−0.06 (−0.12 to 0.01)	−0.25 (−0.36 to −0.13)**	−0.12 (−0.18 to −0.05)**
% Non-Hispanic Black	0.40 (0.25 to 0.54)**	−0.19 (−0.34 to −0.04)*	0.43 (0.29 to 0.58)**	−0.19 (−0.33 to −0.06)**
% Hispanic	0.24 (0.09 to 0.38)**	−0.07 (−0.17 to 0.03)	0.25 (0.10 to 0.39)**	0.04 (−0.06 to 0.14)
% Children living in single-parent home	1.21 (0.96 to 1.46)**	0.92 (0.67 to 1.17)**	1.25 (1.00 to 1.50)**	0.68 (0.43 to 0.94)**
% Individuals with a high school diploma	−1.98 (−2.29 to −1.67)**	−0.94 (−1.23 to −0.65)**	−2.22 (−2.52 to −1.91)**	−0.66 (−0.93 to −0.39)**
Unemployment rate	−0.54 (−1.26 to 0.17)	−0.38 (−0.72 to −0.03)*	−0.51 (−1.25 to 0.23)	−0.69 (−1.00 to −0.37)**
% Individuals living below poverty	2.68 (2.35 to 3.02)**	0.49 (−0.16 to 1.15)	2.93 (2.61 to 3.25)**	−0.22 (−0.85 to 0.40)
% Urban	−0.16 (−0.25 to −0.06)**	−0.05 (−0.12 to 0.02)	−0.15 (−0.25 to −0.05)**	−0.03 (−0.09 to 0.03)
log(GDP/capita)	−44.08 (−50.93 to −37.23)**	15.71 (4.24 to 27.18)**	−53.43 (−60.16 to −46.70)**	5.83 (−4.71 to 16.36)
Medicaid	−0.02 (−0.03 to 0.00)	−0.02 (−0.03 to −0.01)**	−0.01 (−0.03 to 0.00)	−0.02 (−0.03 to −0.02)**
Region				
New England	−25.91 (−28.90 to −22.92)**	−10.24 (−13.18 to −7.31)**	−25.91 (−28.88 to −22.95)**	−6.06 (−8.95 to −3.16)**
Mideast	−18.79 (−21.98 to 15.61)**	−3.29 (−5.97 to −0.60)*	−18.79 (−21.95 to −15.64)**	0.75 (−1.88 to 3.39)
Great Lakes	−12.33 (−15.52 to 9.15)**	0.05 (−2.30 to 2.40)	−12.33 (−15.49 to −9.18)**	1.95 (−0.24 to 4.14)
Plains	−12.96 (−15.80 to −10.12)**	0.32 (−2.10 to 2.75)	−12.96 (−15.78 to −10.14)**	1.75 (−0.50 to 4.00)
Southeast	REF	REF	REF	REF
Southwest	7.65 (4.19 to 11.10)**	6.05 (2.82 to 9.28)**	7.65 (4.22 to 11.07)**	3.70 (0.76 to 6.64)*
Rocky Mountain	−10.38 (−13.56 to −7.20)**	2.87 (−0.32 to 6.06)	−12.11 (−15.54 to −8.69)**	−0.27 (−3.48 to 2.94)
Far West	−10.48 (−13.46 to −7.49)**	−1.31 (−4.41 to 1.80)	−11.47 (−14.63 to −8.32)**	0.26 (−2.57 to 3.08)
Year	−2.50 (−3.47 to −1.53)**	−2.25 (−2.68 to −1.82)**	−2.49 (0.51)**	−1.24 (−1.70 to −0.78)**

*p Value <0.05; **p value <0.01.
State characteristics, including social spending, were lagged 2 years.
†Social spending rate was centred at its mean; unit is per US$1000.
AK, Arkansas; GDP, gross domestic product; WY, Wyoming.

observational findings recognise that many of these programmes are interlinked, and separating their effects may not be realistic in practice.

In summary, greater investment in social services appears to lower teenage birth rates across states in USA. Despite the limitations of this analysis, results suggest a contextual and multilevel approach may be effective for continuing the decline in teenage birth rates.

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