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Parental education and child physical health following the BP Deepwater Horizon oil spill

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Abstract:

Purpose: To assess whether trajectories of children’s physical health problems differ by parental college degree attainment in Louisiana areas highly impacted by the 2010 BP Deepwater Horizon oil spill (BP-DHOS).

Design: Three waves of panel data (2014, 2016, and 2018) from the Gulf Coast Population Impact / Resilient Children, Youth, and Communities studies.

Setting: BP-DHOS-impacted communities in coastal Louisiana.

Participants: Parents of children aged 4-18 in a longitudinal probability sample ($n = 392$).

Measures: Reported child physical health problems from the BP-DHOS, parental college degree attainment, and covariates.

Analysis: Linear growth curve models are used to assess initial levels of and the rate of change in child health problems by parental college degree attainment. Explanatory variables are measured at baseline and the outcome variable is measured at all three waves.

Results: Compared to children of parents without college degrees, children of college graduates had fewer initial health problems in 2014 ($b = -.33$; $p = .02$). Yet, this health advantage decreased over time, as indicated by their positive rate of change ($b = .22$; $p = .01$), such that the higher education health advantage was not statistically significant by 2018.

Conclusion: Children of college graduates experienced a physical health advantage following the BP-DHOS, but this gap closed over time. The closure of the gap was due to the children of college graduates experiencing significant increases in reported health problems over the study period.

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The 2010 BP Deepwater Horizon oil spill (BP-DHOS) is the largest oil spill on record according to amount of shoreline affected.[1] Longitudinal community-based research on the effects of the BP-DHOS have been sparse. Parental educational attainment is a resource identified to mitigate the child health impacts of the BP-DHOS but its relation to trajectories of child health is unknown.[2] The current study uses three waves (2014, 2016, and 2018) of longitudinal data from a probability sample of coastal Louisiana areas highly impacted by the BP-DHOS. Because of the direct connections between the BP-DHOS and children's physical health, we focus on the reported number of children's physical health problems.[3] We examine parental[1] educational attainment due to its importance for child health in previous research.[4]

Data and **Methods**

The analysis relies on longitudinal data (n = 655) from the 2014 Gulf Coast Population Impact (GCPI) study and 2016 (n = 482) and 2018 (n = 481) follow-up data from the Resilient Children, Youth, and Communities (RCYC) study. The GCPI and RCYC surveyed the same sample of households at all three time points. These data are valuable given our objectives because they provide information on children, parents, and household circumstances, track the health of children over time, and are generalizable to the BP-DHOS-affected areas under study. The ages of children studied range from 4 to 18. Institutional Review Boards approval was obtained for the data collection and study procedures at [Louisiana State University and Columbia University].[2,5,6]

Measures

[1] A small number of participants were non-parent guardians.

Data were collected through in-person interviews with an adult parent in the household. The number of child physical health problems were defined as whether the child had respiratory symptoms, vision problems, skin problems, headaches, and/or unusual bleeding (range: 0-5) in the preceding two months. Parental educational attainment was measured using an indicator of college degree attainment (1 = bachelor's degree or greater). Covariates include total people in the household, child gender, child age, parental gender, parental age, parental race-ethnicity, parental marital status, BP-DHOS physical exposure (touching/smelling the oil spill), BP-DHOS economic exposure (job/income loss due to oil spill), and survey wave. Explanatory variables are measured at baseline and the outcome variable is measured at all three waves.

Analysis

To examine initial levels of and changes in child health problems following the BP-DHOS, we use linear growth curve modeling. Growth curve modeling requires nonmissing outcome values for at least three waves, resulting in an analytic sample of 392 respondents. We first estimated an unconditional growth model. We then estimated the effects of parental education and covariates on average initial levels of and rate of change in child health problems. Additional details on sample characteristics, measurement, and analytic method are reported in Supplement Section 1.

Results

Supplement Section 2, Table S1 shows study variable descriptive statistics for the full sample and by parental college degree attainment. Twenty two percent of parents in the sample had a college degree. Children's health problems had a mean of 1.07 at baseline in 2014 and increased modestly at each time point, reaching 1.26 in 2018. In 2014, children of college graduates had fewer initial health problems (mean = .67) compared to children of parents without college degrees (mean = 1.18). This parental education gap in child health problems (1.18 - .76 = .51) narrows in 2016 (1.24 - .92 = .32) and becomes negligible by 2018 (1.29 - 1.17 = .12).

In Table 1, Model 1, an unconditional linear growth curve model shows that the average initial level of child health problems was 1.07 (p < .001) and health problems had an upward .10 (p = .005) rate of change such that children generally had more health problems over time. The intraclass correlation (ICC) from a model predicting child physical health problems with no covariates was .54 (p < .001), indicating that reported child health problems are highly correlated within individuals. A likelihood ratio test indicated that the unconditional growth curve shown in Model 1 provided a better fit compared to a model that only includes variance components for the intercept [LR chi2 (df 2) =14.68 (p < .001)].

Table 1 about here

Model 2 adds college degree attainment and covariates and shows that parental college degree attainment was associated with both initial level of child health problems and child health problem rate of change (see Figure 1). Compared to children of parents without a college degree, college attainment was related to lower levels of child health problems at baseline (b = -.33; p = .02), net of covariates. Yet, the rate of change (b = .22; p = .01) was positive such that the college degree advantage lessened over the study period. That parental college degree is positively associated with initial values of child health problems, but negatively associated with the rate of change in child health problems, indicates a narrowing child health divide across study waves between children of college graduates versus children without college educated parents. Ancillary analysis using three categories of educational attainment is shown in Supplement Section 3.

Figure 1 about here

Discussion

This study shows substantial gaps in child physical health problems by parental educational attainment even after controlling for a range of potentially confounding factors. We found that parental college degree attainment was associated with 1) fewer physical health problems among children following the BP-DHOS in 2014, and 2) a differential rate of change in these health problems. Specifically, whereas children of parents without college degrees consistently had higher levels of health problems over the study period, children of college graduates experienced significant increases in reported health problems from 2014 to 2018. As a result, among parents with college degrees, the lower initial level of reported child health problems in 2014 narrowed in 2016 and closed in 2018. As a multifaceted social resource, higher education may have enabled parents to safeguard children from initial negative health impacts of the oil spill through better knowledge and health behaviors associated with higher education.[7]

We note several limitations to this study. All data, including child health information, came from interviews with an adult parent in the household. Though we control for parent and household background characteristics, we cannot exclude the possibility that unmeasured parent characteristics introduce imprecision. In addition, though this study's probability sample is a strength, a larger sample could facilitate more granular analysis over time and within subpopulations. Finally, as is common in disaster research, our "baseline" data did not precede the BP-DHOS; indeed, they were collected four years after the onset of the spill. Therefore, our BP-DHOS exposure variables (physical and economic) were based on retrospective self-reports and thus subject to recall bias, attribution error, and subjective interpretations of experiences. This is a common limitation in disaster research because such events are, by definition, unanticipated; it takes time to acquire funding and develop study protocols; and there are ethical considerations in surveying people in the immediate aftermath of such an event. Moreover, it would be preferable to be able to validate respondents' recollections with other objective measures of spill exposure. That said, the impacts of disasters on well-being do also depend in part on people's subjective definition of the situation and appraisals of stressors, with their perceptions of impacts being real in their consequences.

In environmentally vulnerable areas such as coastal Louisiana, residents' differential social resources can drive important health inequalities. The current study shows that parental college degree attainment may have made children less vulnerable to the immediate physical health impacts of the BP-DHOS, though in the long run that protective effect wanes. This finding has implications for bolstering initial disaster resilience through improving college degree attainment in communities vulnerable to disaster risk. In addition to the direct consequences of child health problems (e.g., lost days of school and parental work), long-range influences into adulthood include deleterious impacts on educational success, earnings, and later life health.[8] Policymakers can address educational inequalities in order to safeguard the health of children. Improving parents' college degree attainment may have the added benefit of ensuring parental health, family stability, and economic status—all benefits with their own potential added contributions to the health of parents' children.[9] Future research should investigate how educational health gradients might vary in communities vulnerable to environmental disasters and how those gradients shape the long-term well-being of children across the life course.

References

1. Nixon Z, Zengel S, Baker M, et al. Shoreline oiling from the Deepwater Horizon oil spill. *Mar Pollut Bull*. 2016;107(1):170-178. doi:10.1016/j.marpolbul.2016.04.003

2. Beedasy J, Petkova EP, Lackner S, Sury J. Gulf Coast parents speak: children's health in the aftermath of the Deepwater Horizon oil spill. *Environ Hazards*. Published online 2020:1-16.

3. Murray JS. The effects of the gulf oil spill on children. *J Spec Pediatr Nurs*. 2011;16(1):70-74.

4. Lawrence EM, Rogers RG, Hummer RA. Maternal educational attainment and child health in the United States. *Am J Health Promot*. 2020;34(3):303-306.

5. Slack T, Kroeger RA, Stroope S, et al. Deepwater Horizon oil spill exposure and child health: a longitudinal analysis. *Popul Environ*. 2021;42:477-500.

6. Stroope S, Slack T, Kroeger RA, et al. Deepwater Horizon Oil Spill Exposure, Industry Sector, and Child Health. *Popul Res Policy Rev*. Published online March 6, 2021. doi:10.1007/s11113-021-09639-6

7. Zajacova A, Lawrence EM. The Relationship Between Education and Health: Reducing Disparities Through a Contextual Approach. *Annu Rev Public Health*. 2018;39(1):273-289. doi:10.1146/annurev-publhealth-031816-044628

8. Zajacova A, Walsemann KM, Dowd JB. The Long Arm of Adolescent Health Among Men and Women: Does Attained Status Explain Its Association with Mid-Adulthood Health? *Popul Res Policy Rev*. 2015;34(1):19-48.

9. Hout M. Social and economic returns to college education in the United States. *Annu Rev Sociol*. 2012;38:379-400.

10. Slack T, Beedasy J, Chandler T, Keating KS, Sury JJ, Brooks J. Family resilience following the Deepwater Horizon oil spill: theory and evidence. In: Stout M, Harrist AW, eds. *Building Community and Family Resilience: Research, Policy, and Programs*. Springer; 2021:31-48.

11. Abramson DM, Peek LA, Redlener IE, et al. *Children's Health after the Oil Spill: A Four-State Study*. National Center for Disaster Preparedness, Columbia University; 2013. Accessed January 8, 2020. https://doi.org/10.7916/D8WQ0C4P

12. Binson D, Catania JA. Random selection in a national telephone survey: a comparison of the Kish, next-birthday, and last-birthday methods. *J Off Stat*. 2000;16(1):53.

13. *Response Rate Calculator*. American Association for Public Opinion Research; 2020. https://www.aapor.org/Standards-Ethics/Standard-Definitions-(1).aspx

14. U.S. Census Bureau. 2010-2014 American Community Survey 5-Year Estimates. Accessed April 17, 2021. https://data.census.gov/cedsci

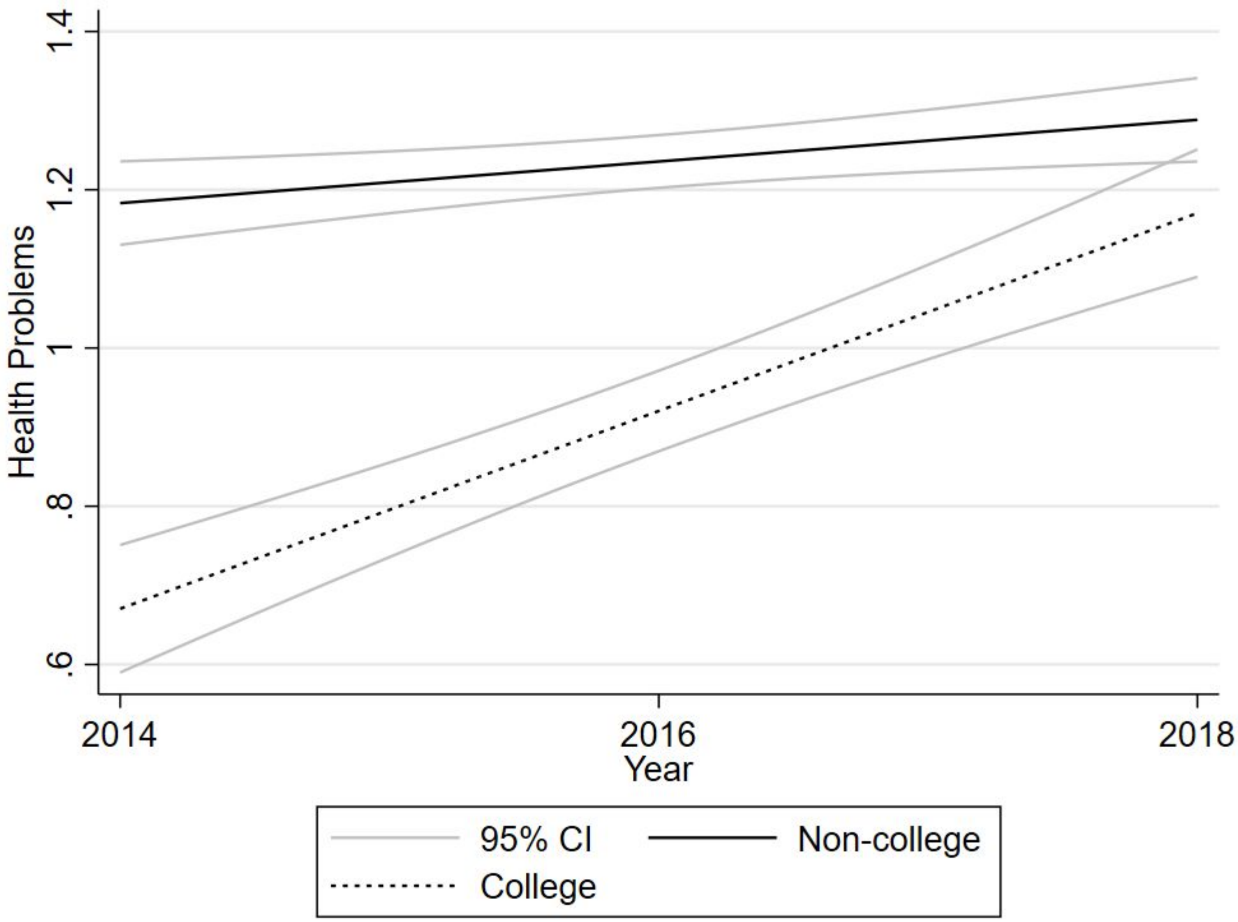
15. Singer JD, Willett JB. *Applied Longitudinal Data Analysis: Modeling Change and Event Occurrence*. Oxford University Press; 2003.

Table 1. Linear growth curve models of child health problems

	Intercept			Slope		
	b	*P*	95% CI	*b*	*P*	95% CI
Model 1						
Constant	1.07	0.000	0.95 - 1.19	0.10	0.005	0.03 - 0.17
Variance Components						
Random Intercept	0.87					
Random Slope				0.08		
Covariance (Intercept, Slope)	0.05					
Residual Error	0.79					
Model 2						
Constant	0.41	0.019	0.07 - 0.74	0.16	0.126	-0.04 - 0.36
College degree	-0.33	0.020	-0.61 - -0.05	0.22	0.011	0.05 - 0.38
Variance Components						
Random Intercept	0.55					
Random Slope				0.04		
Covariance (Intercept, Slope)	0.12					
Residual Error	0.79					

Source: GCPI/RCYC Study (n = 392)

Note: *b* = coefficient; SE=standard error; *P* =two-tailed *P* -value; CI=confidence interval; [a]centered; model 2 controls total people in household, child gender, child age, guadian gender, guadrian age, guardian race-ethnicity, guardian marital status, DHOS physical exposure, DHOS economic exposure, and survey wave



NOTE: Predicted values presented, net of covariates shown in Table 1, Model 2. CI = confidence interval.

Figure 1. Predicted values of child physical health problems across survey years by parental college degree attainment

SO WHAT?

What is Already Known on This Topic?

Parental education is a resource identified to mitigate the child health impacts of the 2010 BP Deepwater Horizon oil spill (BP-DHOS).

What Does This Article Add?

We assess trajectories of children's health and find that children of college graduates experienced a physical health advantage following the BP-DHOS, but this advantage lessened over time.

What are the Implications for Health Promotion Practice or Research?

These results have implications for policies bolstering initial disaster resilience among children through improving college degree attainment in communities vulnerable to disaster risk.

Supplementary Materials

Section 1

Sample

Baseline data were drawn from the 2014 Gulf Coast Population Impact (GCPI) study. Follow-up waves with the same cohort of respondents in 2016 and 2018 came from the Resilient Children, Youth, and Communities (RCYC) study. The protocol involved field interviewers conducting face-to-face household surveys in BP-DHOS affected areas of South Louisiana. The design prioritized child and family experiences.[2,10]

The 2014 GCPI leveraged work on an earlier survey in 2012, which used a multi-stage sampling design to select zip codes, census blocks, and households with children across Gulf South states impacted by the BP-DHOS.[11] In the first stage, an index was calculated to identify spill-affected zip codes. Three measures were used to create the index: 1) individual claims data from the Gulf Coast Claims Facility (zip code), 2) business claims data from the Gulf Coast Claims Facility (zip code), and 3) coastline oiling data from National Oceanic and Atmospheric Administration's Shoreline Cleanup and Assessment Technique (latitude/longitude). Z-scores were calculated for each of the three variables and then summed to create an overall score by zip code. The product was a standardized index where higher values indicated areas with greater impacts from the BP-DHOS. Zip codes were then rank-ordered using the index, and the top-ranked zip codes were then identified as the sampling frame (N = 8 in Louisiana).

Within these zip codes, a two-stage cluster sampling design was utilized to randomly select census blocks and (within the blocks) households with children. More specifically, an average of 15 census blocks per zip code were randomly selected, with target enrollments based on the density of households with children. Drawing on 2010 Census data, blocks were chosen if at least 70% of the households were occupied and if there were at least 5 households with children. Households were approached based on a two-armed protocol:1) if a block had less than 40 occupied households, every household was contacted to establish eligibility; or 2) if a block had more than 40 occupied households, then households were contacted based on data purchased from InfoUSA providing a list of addresses with children in the household. Once a household was contacted, eligibility was determined by the presence of at least one child between the ages of 3 and 18 years old and a parent or child-caregiver of age 18 years or older. To mitigate potential biases in the purchased list, households to the left and right of a selected household were also contacted. In addition, a 1:1 matching household was selected from the block based on random points generated by geographic information system software, and, again, neighbors to the left and right of that household. After an eligible household was recruited, the child in the home with the most recent birthday was identified as the reference for child-focused survey questions and adult respondents were chosen based on their ability to best answer questions about that child.[12]

In 2014, the GCPI team returned to households in Louisiana only. Since the initial surveys conducted in 2012 were anonymous (i.e., previous respondents and reference children could not be established with certainty), the research team revisited the previously interviewed addresses and collected identifiable information from respondents to populate a cohort database going forward. Based on these contacts and resampling where necessary, 720 surveys were completed. This approach yielded a response rate of 45.1% (Rate 4), a cooperation rate of 83.0%

(Rate 4), and a refusal rate of 8.6% (Rate 1).[13] As shown in Table S0, the demographics of the sample produced by this strategy were very comparable to that of regional population data from the U.S. Census Bureau, providing confidence in the generalizability of the sample. The only demographic on which there was not a close match was the percent female, but an oversample of female adults would be expected given the selection criteria (i.e., family households and adult child-caregivers). Moreover, respondent gender is a variable controlled for in our regression models.

Table S0. Comparison of the Sample and Regional Population Demographics

	Sample	Regional Population
Percent Female	62	52
Percent NH-White	63	67
Percent NH-Black	24	23
Percent Other	13	10
Percent College Degree	22	24
Number in Household	4	3

Note: Regional population statistics were calculated as an average across the six parishes from which respondents were selected using data from the U.S. Census Bureau, 2010-2014 American Community Survey 5-Year Estimates.[14]

Of those surveyed in 2014, 655 agreed to be contacted for subsequent waves of data collection (91% of the sample). The RCYC then conducted follow-up interviews with the same adults and centered on the same focal children in 2016 and 2018. Out of the 655 respondents from 2014, approximately 74% were re-interviewed in 2016 (N=482) and 2018 (N=481). Reasons for attrition included inability to relocate respondents, refusals, mortality, and incarceration. To assess potential bias introduced by these cases, we examined the correlation between attrition and the study's outcome variable. Results showed that there was no selection due to attrition on the outcome variable, i.e., the outcome was not significantly correlated with being in one wave ($p = 0.510$), two waves ($p = 0.594$), or three waves ($p = 0.326$) of the survey.

Field researchers conducted the interviews in person and recorded responses on a programmed tablet. Informed consent was obtained by having participants provide their electronic signature on interviewer tablets. The data collection and study procedures were approved by the Institutional Review Boards of [authors' universities].

Outcome variable

Child physical health problems (henceforth health problems) were recorded in each survey wave (2014, 2016, and 2018) by asking the child's parent whether the child had any of the following in the preceding two months: (1) respiratory symptoms such as shortness of breath, wheezing or tightness in chest, burning in their nose, throat or lungs; (2) vision problems such as watery, burning or itchy eyes, blurred or distorted vision; (3) skin problems such as a skin rash, sore or blister that lasted three or more days; (4) headaches; or (5) unusual bleeding, such as nosebleeds, ear bleeds, or excessive menstrual bleeding (girls only). The measure had a range of zero to five and good reliability (2014 $\alpha = .63$, 2016 $\alpha = .70$, 2018 $\alpha = .74$).

Explanatory variable

Parent college degree attainment. Parents were asked about their highest level of education completed in 2014. Response options were: (1) some grade school; (2) some high school; (3) high school graduate (or GED); (4) vocational or technical school beyond high school; (5) community college (associate degree); (6) some college, no degree; (7); college (bachelor's degree); (8) master's degree; or (9) Ph.D., M.D., J.D. or similar. Due to relatively small cell sizes in the analytic sample, this survey question was collapsed into a college degree attainment indicator (1 = bachelor's degree or higher, 0 = less than a bachelor's degree).

Covariates

Control variables were measured in 2014 and included total people in the household, child gender (1 = female), child age in years, parent gender (1= female), parent age in years, parent race-ethnicity (NH-White, NH-Black, other race-ethnicity), parent marital status indicator (1 = married), BP-DHOS physical exposure (1 = child/parent smelled or had physical contact with the oil spill), BP-DHOS economic exposure (1 = a household member lost job/income due to the BP-DHOS), and survey wave.

Analysis

We assessed whether trajectories of health problems differed for children of college graduates compared to children with a parent who did not graduate from college. First, we estimated descriptive statistics for the full sample and by parent college degree attainment. Second, linear growth curve models estimated the effects of parent college degree attainment on both initial health problems and change in health problems over time. All models were estimated in Stata 16.1.

The linear growth curve models [15] were based on the following equation:

$$y_{it} = \beta_{00} + \beta_{10}T_{it} + U_{0i} + U_{1i}T_{it} + \varepsilon_{it}$$

where y_{it} represents health problems for individual i at time t; β_{00} represents the fixed intercept (i.e. the population average initial health problems); β_{10} represents the fixed slope (i.e. the population average rate of change in health problems); T_{it} denotes the time score equal to 0 when $t = 1$ (i.e., 2014), equal to 1 when $t = 2$ (i.e., 2016), and equal to 2 when $t = 3$ (i.e., 2018); U_{0i} represents the random intercept (i.e. the unexplained individual factors affecting initial health problems); U_{1i} represents the random slope (i.e. the unexplained individual factors affecting the rate of change in health problems); and ε_{it} represents random variation in health problems for individual i at time t.[2]

Section 2

Table S1 shows study variable descriptive statistics for the full sample and by parent college degree attainment.

Table S1. Study variable descriptive statistics

	Mean, SD / Proportion, n					
	Full sample[a]		Non-college[b]		College[c]	
Health problems, 2014 (child)	1.07	1.29	1.18	1.33	0.67	1.07
Health problems, 2016 (child)	1.17	1.37	1.24	1.40	0.92	1.21
Health problems, 2018 (child)	1.26	1.48	1.29	1.50	1.17	1.42
College Degree	0.22	88				
Total People in Household	4.32	1.39	4.38	1.46	4.11	1.09
Female (child)	0.43	168	0.43	131	0.42	37
Age (child)	11.64	4.18	11.45	4.15	12.31	4.24
Female	0.62	243	0.60	181	0.70	62
Age	42.45	10.77	42.34	11.30	42.85	8.73
Race-Ethnicity						
NH-White (ref.)	0.63	245	0.60	182	0.72	63
NH-Black	0.24	95	0.26	78	0.19	17
Other	0.13	52	0.14	44	0.09	8
Married	0.71	279	0.66	200	0.90	79
Physical exposure	0.51	199	0.53	160	0.44	39
Economic exposure	0.37	144	0.43	131	0.15	13

Source: GCPI/RCYC Study
Note: Health problems = recent physical child health problems; all variables from 2014 and refer to guardian characteristics unless otherwise indicated; [a]n = 392, [b]n = 304, [c]n=88

[2] The changes in health problems are not simply the result of changes in age. The same children were interviewed in Wave 1 (mean age = 11.64), Wave 2 (mean age = 14.58), and Wave 3 (mean age = 16.04). While there was some variation in exact duration between waves, each child was interviewed approximately every 2 years. Therefore, across waves age is nearly perfectly correlated: Wave 1 & 2 = .998, Wave 1 & 3 = .993, and Wave 2 & 3 = .993. By controlling for age at Wave 1, the effect of time net of the effect of age is estimated.

Table S2 shows the results shown in model 2 of table 1 along with covariate results.

Table S2. Linear growth curve model of child health problems

	Intercept			Slope		
	b	*P*	95% CI	*b*	*P*	95% CI
Constant	0.41	0.019	0.07 - 0.74	0.16	0.126	-0.04 - 0.36
College degree	-0.33	0.020	-0.61 - -0.05	0.22	0.011	0.05 - 0.38
Total People in Household[a]	0.05	0.361	-0.06 - 0.17	-0.04	0.297	-0.10 - 0.03
Female (child)	0.20	0.076	-0.02 - 0.43	0.15	0.031	0.01 - 0.28
Age (child)[a]	0.17	0.004	0.06 - 0.29	-0.09	0.015	-0.16 - -0.02
Female	0.26	0.030	0.03 - 0.50	0.02	0.735	-0.12 - 0.17
Age[a]	0.04	0.562	-0.09 - 0.17	-0.02	0.531	-0.10 - 0.05
Race-Ethnicity						
NH-White (ref.)						
NH-Black	0.35	0.013	0.07 - 0.62	-0.12	0.153	-0.28 - 0.04
Other	0.23	0.172	-0.10 - 0.57	-0.20	0.047	-0.41 - 0.00
Married	-0.12	0.362	-0.39 - 0.14	-0.08	0.329	-0.24 - 0.08
Physical exposure	0.61	0.000	0.37 - 0.84	-0.21	0.003	-0.35 - -0.07
Economic exposure	0.42	0.001	0.17 - 0.67	0.09	0.248	-0.06 - 0.24
Variance Components						
Random Intercept	0.55					
Random Slope				0.04		
Covariance (Intercept, Slope)	0.12					
Residual Error	0.79					

Source: GCPI/RCYC Study (n = 392)

Note: *b* = coefficient; SE=standard error; *P* =two-tailed *P* -value; CI=confidence interval; [a]centered

Section 3

Supplementary Analyses

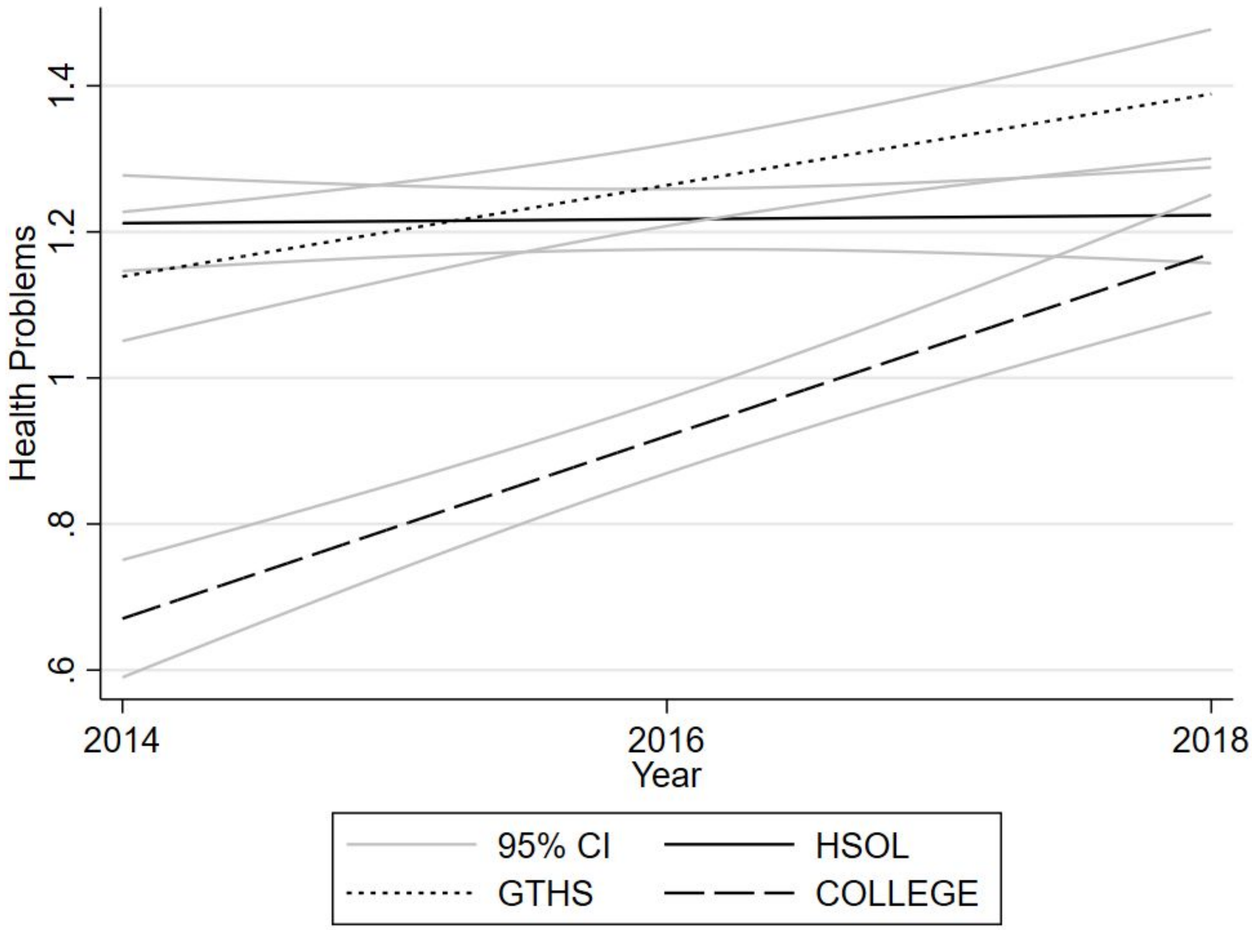
In ancillary analyses, we investigated whether an alternate coding strategy for parent educational attainment yielded substantially different results. Because relatively few respondents in the analytic sample completed less than a high school education (n = 69), these respondents were combined with high school graduates. The resultant parent educational attainment categorization scheme was: high school degree or less (HSOL); greater than high school education (GTHS); and bachelor's degree (COLLEGE). HSOL was set as the reference category to assess whether the initial level of health problems and the rate of change of health problems differed for HSOL compared to GTHS and COLLEGE. Results in Table S3 show that HSOL and GTHS did not significantly differ from one another in terms of initial level or rate of change. Only COLLEGE differed in initial level (p=.015) of health problems and rate of change (p=.004). This sensitivity analysis suggests that the most important educational attainment difference in the data was between health problems among children of college-educated parents and children of non-college-educated parents. Predicted levels of health problems by parent educational attainment are shown in Figure S1 using results from the model in Table S3.

Table S3. Linear growth curve model of child health problems

	Intercept			Slope		
	b	*P*	95% CI	*b*	*P*	95% CI
Constant	0.42	0.015	0.08 - 0.76	0.14	0.188	-0.07 - 0.34
Education						
HSOL (ref.)						
GTHS	-0.09	0.497	-0.35 - 0.17	0.11	0.157	-0.04 - 0.27
COLLEGE	-0.37	0.015	-0.67 - -0.07	0.26	0.004	0.08 - 0.44
Total People in Household[a]	0.05	0.370	-0.06 - 0.17	-0.04	0.315	-0.10 - 0.03
Female (child)	0.20	0.077	-0.02 - 0.43	0.15	0.029	0.01 - 0.28
Age (child)[a]	0.17	0.004	0.06 - 0.29	-0.09	0.013	-0.16 - -0.02
Female	0.27	0.025	0.03 - 0.51	0.01	0.851	-0.13 - 0.16
Age[a]	0.03	0.602	-0.09 - 0.16	-0.02	0.611	-0.10 - 0.06
Race-Ethnicity						
NH-White (ref.)						
NH-Black	0.36	0.011	0.08 - 0.63	-0.13	0.112	-0.30 - 0.03
Other	0.23	0.180	-0.11 - 0.57	-0.20	0.053	-0.40 - 0.00
Married	-0.11	0.438	-0.38 - 0.16	-0.10	0.223	-0.26 - 0.06
Physical exposure	0.61	0.000	0.37 - 0.84	-0.21	0.004	-0.35 - -0.07
Economic exposure	0.42	0.001	0.17 - 0.67	0.08	0.289	-0.07 - 0.23
Variance Components						
Random Intercept	0.55					
Random Slope				0.04		
Covariance (Intercept, Slope)	0.12					
Residual Error	0.79					

Source: GCPI/RCYC Study (n = 392)

Note: *b* = coefficient; SE=standard error; *P* =two-tailed *P* -value; CI=confidence interval; [a]centered; HSOL=less than high school; GTHS=greater than high school; COLLEGE= Bachelor's degree or greater



NOTE: Predicted values presented, net of covariates shown in Table S3. CI = 95% confidence interval; HSOL = high school degree or less (HSOL); GTHS = greater than high school education; COLLEGE = bachelor's degree or greater

Figure S1. Predicted values of child physical health problems across survey years by parent high school degree or less, greater than high school, or bachelor's degree attainment

References

1. Nixon Z, Zengel S, Baker M, et al. Shoreline oiling from the Deepwater Horizon oil spill. *Mar Pollut Bull*. 2016;107(1):170-178. doi:10.1016/j.marpolbul.2016.04.003

2. Beedasy J, Petkova EP, Lackner S, Sury J. Gulf Coast parents speak: children's health in the aftermath of the Deepwater Horizon oil spill. *Environ Hazards*. Published online 2020:1-16.

3. Murray JS. The effects of the gulf oil spill on children. *J Spec Pediatr Nurs*. 2011;16(1):70-74.

4. Lawrence EM, Rogers RG, Hummer RA. Maternal educational attainment and child health in the United States. *Am J Health Promot*. 2020;34(3):303-306.

5. Slack T, Kroeger RA, Stroope S, et al. Deepwater Horizon oil spill exposure and child health: a longitudinal analysis. *Popul Environ*. 2021;42:477-500.

6. Stroope S, Slack T, Kroeger RA, et al. Deepwater Horizon Oil Spill Exposure, Industry Sector, and Child Health. *Popul Res Policy Rev*. Published online March 6, 2021. doi:10.1007/s11113-021-09639-6

7. Zajacova A, Lawrence EM. The Relationship Between Education and Health: Reducing Disparities Through a Contextual Approach. *Annu Rev Public Health*. 2018;39(1):273-289. doi:10.1146/annurev-publhealth-031816-044628

8. Zajacova A, Walsemann KM, Dowd JB. The Long Arm of Adolescent Health Among Men and Women: Does Attained Status Explain Its Association with Mid-Adulthood Health? *Popul Res Policy Rev*. 2015;34(1):19-48.

9. Hout M. Social and economic returns to college education in the United States. *Annu Rev Sociol*. 2012;38:379-400.

10. Slack T, Beedasy J, Chandler T, Keating KS, Sury JJ, Brooks J. Family resilience following the Deepwater Horizon oil spill: theory and evidence. In: Stout M, Harrist AW, eds. *Building Community and Family Resilience: Research, Policy, and Programs*. Springer; 2021:31-48.

11. Abramson DM, Peek LA, Redlener IE, et al. *Children's Health after the Oil Spill: A Four-State Study*. National Center for Disaster Preparedness, Columbia University; 2013. Accessed January 8, 2020. https://doi.org/10.7916/D8WQ0C4P

12. Binson D, Catania JA. Random selection in a national telephone survey: a comparison of the Kish, next-birthday, and last-birthday methods. *J Off Stat*. 2000;16(1):53.

13. *Response Rate Calculator*. American Association for Public Opinion Research; 2020. https://www.aapor.org/Standards-Ethics/Standard-Definitions-(1).aspx

14. U.S. Census Bureau. 2010-2014 American Community Survey 5-Year Estimates. Accessed April 17, 2021. https://data.census.gov/cedsci

15. Singer JD, Willett JB. *Applied Longitudinal Data Analysis: Modeling Change and Event Occurrence*. Oxford University Press; 2003.

In Brief

Prior research shows that parental education is a resource that can mitigate the child health impacts of the 2010 BP Deepwater Horizon oil spill (BP-DHOS). We add to prior research assessing trajectories of children's health and finding that children of college graduates experienced a physical health advantage following the BP-DHOS, but this advantage lessened over time. These results have implications for policies bolstering initial disaster resilience among children through improving college degree attainment in communities vulnerable to disaster risk.