**Disruption to Test Scores after Tropical Cyclones in the United States**

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**Abstract**

**Significance Statement**

**Main Text**

**Introduction**

**Results**

**Discussion**

**Materials and Methods**

*Outcomes*

We ascertained educational attainment based on annual standardized test scores in math and reading/language arts administered in the spring to public school students in third to eighth grade as mandated by the No Child Left Behind Act of 2001 (1). We retrieved average test score data aggregated at the county level from the Stanford Education Data Archive (SEDA), which were available for academic years during 2008-2009 to 2017-2018 (2). States were included if they contained at least one county that experienced at least one tropical cyclone during our study period. SEDA data adjusted for interstate differences in academic proficiency using the National Assessment of Educational Progress (NAEP), an annual exam administered at the same time on the same academic content to a representative sample of US students (3). The SEDA test scores are scaled such that a score of 4 is equal to the average national NAEP score across four cohorts of students in fourth grade in the spring of 2009, 2011, 2013, and 2015. According to SEDA documentation, “1 unit in this metric is equal to the average per-grade increase in scores between fourth and eighth grade for those same cohorts, assuming usual grade promotion.” This allows scores to be comparable across the entire US, over time, and across grades (2).

*Exposure*

We obtained data on tropical cyclone wind exposure in the US with full space and time coverage over the study period of 2008 to 2018 from publicly available datasets generated by Anderson et al. (4–6). We used daily estimates of maximum wind sustained speed by county to classify exposures on an annual basis. Hurricane exposure was defined by peak sustained winds in a county’s population center associated with a tropical cyclone at the point of closest approach reached or exceeded 64 knots or 74 miles per hour. Gale-to-violent storm exposure was defined similarly as days reaching or exceeding 34 knots or 39 miles per hour, but less than 64 knots or 74 miles per hour.

*Covariates*

Time-varying covariates at both the grade cohort and county level were provided by SEDA and derived from the American Community Survey and the Common Core of Data (2). At the grade cohort level, covariates included the percentage of students who identified as Black, Hispanic, Asian, and American Indian/Alaska Native; the percentage of students who received free and reduced lunch; the percentage of students who were English language learners; and the percentage of students who were considered economically disadvantaged. At the county level, covariates included the percentage of students in urban, suburban, town, and rural locale schools; median annual household income; the percentage of county residents with a college degree; percentage of county residents living in poverty; percentage of county residents receiving Supplemental Nutrition Assistance Program (SNAP) benefits; and the percentage of households headed by single mothers.

*Statistical analysis*

We developed a difference-in-differences model to assess the association between tropical cyclone exposure and average annual standardized test scores at the county level. If a given county had been exposed to a hurricane or tropical cyclone in a particular year, all associated grade cohorts were treated as exposed for the remainder of the study period.

*Sensitivity analysis*

**Acknowledgements**

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**Figure 1**

**Figure 2**

**Figure 3**

**Table 1**