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Supplemental Material

Health Effects of Cyclones: A Systematic Review and Meta-Analysis of Epidemiological Studies

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Figure S4. Contour-enhanced funnel plot analysis on the detection of publication bias in the meta-analysis of the association between cyclone exposures and preterm birth, with background color indicating the significance of the studies ($P \geq 0.05$: white background; $P < 0.05$: dark blue; $P < 0.025$: blue; $P < 0.01$: light blue).

References

Table S1. Search strategies and initial results, organised by database

#	Query	Results
Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations, Daily and Versions <1946 to December 21, 2022>		
1	exp Cyclonic Storms/	2,890
2	tropical storm*.mp.	272
3	(cyclon* or hurricane* or typhoon*).mp.	8,948
4	1 or 2 or 3	9,047
5	morbidity/ or mortality/ or "cause of death"/	126,230
6	patient care/ or hospitalization/ or patient admission/ or patient discharge/ or patient readmission/	212,876
7	patients/ or inpatients/	50,242
8	exp disease/ or exp disease attributes/	1,777,766
9	emergency service, hospital/ or trauma centers/ or exp Emergency Medical Services/ or Ambulances/ or Air Ambulances/	165,388
10	exp "Wounds and Injuries"/	992,668
11	exp "diseases (non mesh)"/	16,674,666
12	mental health/ or mental disorders/ or exp anxiety disorders/ or exp mood disorders/ or exp "trauma and stressor related disorders"/ or mental health services/	471,347
13	exp pregnancy/ or exp pregnancy outcome/	988,078
14	exp pregnancy/ or exp pregnancy outcome/ or exp pregnancy complications/	1,020,885
15	(health* or disease* or mortalit* or morbidit* or hospital* or admission* or injur* or traum* or emergency or emergencies or ambulanc*).mp.	13,023,855
16	(pregnan* or gestation* or maternal or preterm* or pre term* or pre matur* or prematur* or post matur* or postmatur* or abortion* or stillbirth* or still birth*).mp.	1,463,058
17	(asthm* or cardio* or cardia* or myocardi* or allerg* or respirator* or COPD or lung diseas* or lung function* or pulmonary disease* or bronchopulmonary or mental health* or mental illness* or mental wellbeing or mental well being or sleep* or disorder* or insomni*).mp.	5,342,787
18	5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17	21,966,162
19	4 and 18	4,581
20	exp animals/ not humans.sh.	5,075,475
21	19 not 20	4,358
Embase Classic+Embase <1947 to December 21, 2022>		
1	exp hurricane/	5,042
2	(cyclon* or hurricane* or typhoon*).mp.	12,105
3	tropical storm*.mp.	281
4	1 or 2 or 3	12,219
5	exp morbidity/ or exp mortality/	1,566,655
6	"cause of death"/	138,013
7	exp patient/	3,292,478
8	hospital admission/ or hospital discharge/ or hospital readmission/ or hospitalization/	880,410
9	emergency ward/	194,603
10	emergency health service/ or emergency medical dispatch/ or hospital emergency service/ or psychiatric emergency service/	124,082
11	ambulance/	16,319
12	air medical transport/	3,410
13	exp injury/	2,787,498
14	exp mental health/	220,353
15	mental disease/ or exp anxiety disorder/ or exp mood disorder/ or exp psychotrauma/	1,035,374
16	exp mental health service/	67,630
17	diseases/ or exp "general aspects of disease"/ or exp physical disease/	27,039,908
18	sleep/ or sleep quality/ or sleep deprivation/	161,940
19	pregnancy outcome/	76,472
20	exp pregnancy disorder/	688,676
21	exp pregnancy/	887,130
22	(health* or disease* or mortalit* or morbidit* or hospital* or admission* or injur* or traum* or emergency or emergencies or ambulanc*).mp.	18,338,379

23	(pregnan* or gestation* or maternal or preterm* or pre term* or pre matur* or prematur* or post matur* or postmatur* or abortion* or stillbirth* or still birth*).mp.	1,778,668
24	(asthm* or cardio* or cardia* or myocardi* or allerg* or respirator* or COPD or lung diseas* or lung function* or pulmonary disease* or bronchopulmonary or mental health* or mental illness* or mental wellbeing or mental well being or sleep* or disorder* or insomni*).mp.	7,887,625
25	or/5-24	30,831,072
26	4 and 25	7,216
27	(exp animal/ or exp invertebrate/ or animal.hw. or nonhuman/) not exp human/	7,875,640
28	26 not 27	6,454
29	limit 28 to medline	2,270
30	28 not 29	4,184
Pubmed <1947 to December 21, 2022>		
1	"Cyclonic Storms"[MeSH]	2,881
2	cyclon*[Title/Abstract] OR hurricane*[Title/Abstract] OR typhoon*[Title/Abstract] OR "tropical storm*"[Title/Abstract]	8,047
3	#1 OR #2	8,602
4	Disease[MeSH] OR Mortality[MeSH] OR Morbidity[MeSH] OR "Wounds and Injuries"[MeSH] OR Patients[MeSH] OR "Cause of Death"[MeSH]	2,201,592
5	Sleep[MeSH] OR "Mental Health"[MeSH]	151,259
6	Pregnancy[MeSH] OR "Pregnancy Outcome"[MeSH] OR "Pregnancy Outcome"[MeSH] OR "Pregnancy Complications"[MeSH]	1,020,573
7	(health* OR injur* OR morbid* OR mortal* OR wound* OR stunting* OR rupture* OR burn* OR death* OR fracture* OR incidence* OR diseas* OR patient OR inpatients OR hospital* OR admission* OR emergen* OR ambulanc* OR epidemiolog* OR nutrition* OR pregnan* OR gestation* OR maternal OR preterm* OR pre-term* OR prematur* OR pre-matur* OR post-matur* OR postmatur* OR abortion* OR stillbirth* OR still-birth* OR cardio* OR allerg* OR respirat* OR infect* OR communicab* OR status OR effect* OR traum* OR sleep* OR insomni* OR mental* OR anxiety OR mood OR stress* OR disorder*)[Title/Abstract]	25,811,266
8	#4 OR #5 OR #6 OR #7	25,875,999
9	#3 AND #8	6,388
10	# 9 Filters: Humans	3,781
SCOPUS <1955 to December 21, 2022>		
(TITLE-ABS-KEY (cyclon* OR hurricane* OR typhoon* OR "tropical storm*")) AND ((TITLE-ABS-KEY ((health* OR disease* OR mortalit* OR morbidit* OR hospital* OR admission* OR injur* OR traum* OR emergency OR emergencies OR ambulanc*)) OR TITLE-ABS-KEY ((pregnan* OR gestation* OR maternal OR preterm* OR "pre term*" OR "pre matur*" OR prematur* OR "post matur*" OR postmatur* OR abortion* OR stillbirth* OR "still birth*")) OR TITLE-ABS-KEY ((asthm* OR cardio* OR cardia* OR myocardi* OR allerg* OR respirator* OR copd OR "lung diseas*" OR "lung function*" OR "pulmonary disease*" OR bronchopulmonary OR "mental health*" OR "mental illness*" OR "mental wellbeing" OR "mental well being" OR sleep* OR disorder* OR insomni*)))) AND (EXCLUDE (SUBJAREA , "ENVI") OR EXCLUDE (SUBJAREA , "SOCI") OR EXCLUDE (SUBJAREA , "ENGI") OR EXCLUDE (SUBJAREA , "EART") OR EXCLUDE (SUBJAREA , "AGRI") OR EXCLUDE (SUBJAREA , "COMP") OR EXCLUDE (SUBJAREA , "BUSI") OR EXCLUDE (SUBJAREA , "ENER") OR EXCLUDE (SUBJAREA , "BIOC") OR EXCLUDE (SUBJAREA , "ARTS") OR EXCLUDE (SUBJAREA , "MATH") OR EXCLUDE (SUBJAREA , "DECI") OR EXCLUDE (SUBJAREA , "MATE") OR EXCLUDE (SUBJAREA , "MULT") OR EXCLUDE (SUBJAREA , "PHYS") OR EXCLUDE (SUBJAREA , "CENG") OR EXCLUDE (SUBJAREA , "CHEM") OR EXCLUDE (SUBJAREA , "ECON") OR EXCLUDE (SUBJAREA , "VETE") OR EXCLUDE (SUBJAREA , "Undefined")) AND (EXCLUDE (EXACTKEYWORD , "Nonhuman") OR EXCLUDE (EXACTKEYWORD , "Animals") OR EXCLUDE (EXACTKEYWORD , "Animal"))		3,599

WEB OF SCIENCE Core Collection <1891 to December 21, 2022>	
cyclon* OR hurricane* OR typhoon* OR "tropical storm*" (Topic) and health* OR disease* OR mortalit* OR morbidit* OR hospital* OR admission* OR injur* OR traum* OR emergency OR emergencies OR ambulanc* OR pregnan* OR gestation* OR maternal OR preterm* OR "pre term*" OR "pre matur*" OR prematur* OR "post matur*" OR postmatur* OR abortion* OR stillbirth* OR "still birth*" OR asthm* OR cardio* OR cardia* OR myocardi* OR allerg* OR respirator* OR copd OR "lung diseas*" OR "lung function*" OR "pulmonary disease*" OR bronchopulmonary OR "mental health*" OR "mental illness*" OR "mental wellbeing" OR "mental well being" OR sleep* OR disorder* OR insomni* (Topic) and Engineering or Toxicology or Plant Sciences or Pathology or Zoology or Computer Science or Marine Freshwater Biology or Business Economics or Water Resources or Science Technology Other Topics or Immunology or Education Educational Research or Nursing or Food Science Technology or Telecommunications or Information Science Library Science or Physical Geography or Substance Abuse or Mining Mineral Processing or Legal Medicine or Robotics or Agriculture or Mathematics or Energy Fuels or Pharmacology Pharmacy or Public Administration or Government Law or Instruments Instrumentation or Oceanography or Mathematical Computational Biology or Geochemistry Geophysics or Chemistry or Geology or Biodiversity Conservation or Forestry or Geography or Entomology or Fisheries or Surgery or Transportation or Materials Science or Anatomy Morphology or History or Remote Sensing or Neurosciences Neurology or Construction Building Technology or Architecture or Cultural Studies or Arts Humanities Other Topics or International Relations or Cell Biology or Hematology or Automation Control Systems or Physics (Exclude – Research Areas)	4,169

Table S2. Criteria for the risk of bias assessment for included studies, adapted from the Office of Health Assessment and Translation (OHAT)[1]

Bias	Domains	Ratings	
Key Criteria	Detection bias, exposure assessment	**Can we be confident in the exposure characterization?**	
		Low	There is direct evidence that exposure assessment involved representative and reliable measurements of cyclone exposure and a low risk of exposure misclassification (e.g., assessed exposure at individual level, accounted for the persistent and time-varying cyclone exposures)
		Probably low	There is indirect evidence that the exposure assessment involved representative and reliable measurements of cyclone exposure and a low risk of exposure misclassification
		Probably high	There is indirect evidence that the cyclone exposure assessment involved representative and reliable measurements, but could introduce a high risk of exposure misclassification (e.g., exposure assessment was based on a static point-in-time estimate like cyclone hit date that did not account for the cyclone end date, nor consider the persistent or time-varying cyclone exposures) OR There is insufficient information provided about the exposure assessment to judge the validity and reliability, but no evidence for concern about the method used.
		High	There is direct evidence that poorly reliable and representative measurements were used to assess cyclone exposure
	Detection bias, outcome assessment	**Can we be confident in the outcome assessment?**	
		Low	There is direct evidence that outcome data are from a reliable data source or defined based on standard diagnosis criteria (e.g., International Classification System [ICD] code) OR Studies provide evidence of quality assurance of outcome data.
		Probably low	There is indirect evidence that outcome was assessed or defined using acceptable methods OR It is deemed that the outcome assessment methods used would not appreciably bias results (e.g., objectively measured and quality controlled).
		Probably high	Outcome was not assessed based on standard diagnosis criteria and there is evidence that suggests the existence of misclassification bias (e.g., objectively measured but less of quality control procedure of measurement) OR There is insufficient information provided about the outcome assessment to judge the validity and reliability, but no evidence for concern about the method used.
		High	Outcome was obtained or defined based on self-reports (parents, family) and data collected, criteria developed by the researcher OR There is direct evidence that suggests the high risk of outcome misclassification bias.
	Confounding bias	**Did the study design or analysis sufficiently account for important confounding variables?**	
		Low	Study accounted for all important confounders which were measured consistently (e.g., age, gender, race/ethnicity, education level, household income, health status for cross-sectional, cohort and case-control studies; time trend, seasonality, day of week, public holiday, variation in expected number of outcomes for time-series study; social-economic status, region, variation in expected number of the outcome).

		Probably low	Study accounted for most of confounders AND is not expected to introduce bias.
		Probably high	Study accounted for some but not all confounders AND is expected to introduce bias.
		High	Study did not account for potential confounders OR were inappropriately measured.
Other Criteria	Selection bias	**Did selection of study participants result in appropriate comparison groups?**	
		Low	The descriptions of the studied population were sufficiently detailed to support the assertion that risk of selection effects was minimal (e.g., study participants in different exposure levels and with all outcomes had equal opportunity to be included in the study).
		Probably low	There is insufficient information about population selection to permit a judgment of low risk of bias, but there is indirect evidence that suggests low risk of bias (e.g., study participants in different exposure levels may not have equal opportunity to be in the study).
		Probably high	There is insufficient information about population selection to permit a judgment of high risk of bias, but there is indirect evidence that suggests high risk of bias (e.g., participants in all exposure levels did not have equal opportunity to be in the study; but not to the extent that seriously bias the effect estimates).
		High	There were indications from descriptions of the studied population of high risk of bias (study only included designated high-risk participants, and participants in all exposure levels did not have equal opportunity to be in the study, to the extent that effect estimates were seriously biased).
	Attrition/exclusion bias	**Were outcome data complete without attrition or exclusion from analysis?**	
		Low	No missing data irrelevant to the true study outcome and no missing outcome data
		Probably low	Though not sufficient information available to evaluate the incomplete data's risk accurately, there was indirect evidence indicating a low risk of bias.
		Probably high	Inadequate information provided to determine whether a risk was high about incomplete data, but there was indirect evidence to suggest a high risk.
		High	Direct evidence to suggest that the missing data on outcomes is relevant to the true study outcome
	Selective reporting bias	**Did the study report all measured outcomes?**	
		Low	The study reported findings on all pre-specified outcomes
		Probably low	Inadequate information provided to determine whether a risk of selective outcome was low, but there was indirect evidence to suggest that study was not selectively reported
		Probably high	Inadequate information provided to determine whether a risk of selective outcome was low, but there was indirect evidence to suggest that study was selectively reported
		High	The study did not report findings on all pre-specified outcomes, or used methods that were not pre-specified to analyze one/more of the primary outcomes or report the outcomes/findings that were not pre-specified
	Conflict of interest	Was there potential bias in the reporting through financial sources?	

		Low	No funding was received for this study from entities with a financial interest in the study outcomes.
		Probably low	Inadequate information provided to to determine a low risk, but there was indirect evidence to suggest that the study had no financial interest
		Probably high	Inadequate information provided to to determine a low risk, but there was indirect evidence to suggest that the study had financial interest
		High	Support was received for this study from entities with a financial interest in the study outcomes.
	Other source of bias	**Bias from other sources not covered elsewhere (statistical methodological appropriateness, researcher compliance with study protocol)**	
		Low	No other sources of bias
		Probably low	Inadequate information provided to determine a low risk, but there was indirect evidence to suggest that the study had no other problems
		Probably high	Inadequate information provided to determine a low risk, but there was indirect evidence to suggest that the study had other problems
		High	At least one important bias detected from other sources

Table S3: Summary of the basic characteristics of the included studies.

Leading author, year	Study period	Study settings	Study design	Study population (age)	Sample size	Exposure assessment method	Included Cyclone(s)	Exposure window	Comparison	Outcome	Statistical methods*	Estimates
Begum et al. (2022)[2]	2001-2015	New York, US	Case-crossover	General population (≥ 64 years)	NA	FEMA-designated	Hurricane Sandy	3 years	94-month period prior to exposure	Mental health-related ED visit and hospitalizations	Time-stratified Poisson regression model	Relative risk for ED visits of mental health (1.10, 95% CI: 1.08, 1.13); no significant increase for hospitalizations of mental health
Parks et al. (2022)[3]	1988-2018	US	Case-crossover	General population (All Ages)	33,619,393	Wind field model (maximum sustained winds ≥17.4 m/s)	All TCs hit US between 1988–2018	6 months	Same months in other non-exposure years	Cause-specific mortality	Bayesian conditional quasi-Poisson model	3.7% (95% CrI: 2.5%, 4.9%) increased monthly death rates for injuries; 1.8% (95% CrI: 0.1%, 3.6%) for infectious and parasitic diseases; 1.3% (95% CrI, 0.2%, 2.4%) for respiratory diseases; 1.2% (95% CrI, 0.6%, 1.7%) for cardiovascular diseases; 1.2% (95% CrI, 0.1%, 2.4%) for neuropsychiatric conditions; no significant increase for cancer mortality per 1-day increase in TCs in a month
Bell et al. (2022)[4]	2004-2012	US	Case-crossover	General population (≥ 65 years)	3,629,637	FEMA-designated	Eight large-scale hurricanes	30 days	240-day period prior to exposure	Cause-specific hospitalizations	Conditional Poisson regression model	Incidence rate ratio for hospitalizations for diabetes (1.06, 95% CI: 1.03, 1.10), COPD (1.06, 95% CI: 1.04, 1.08), and congestive heart failure (1.19, 95% CI: 1.17, 1.21)
Quist et al. (2022)[5]	2016-2019	North Carolina, US	Time series	General population	about 1,460 (daily observations)	Flood extents (one third or more of the area was flooded)	Hurricanes Matthew and Florence	3 weeks	All non-exposure days	ED visits for acute gastrointestinal illness	Controlled interrupted time series	Relative risk (1.11, 95% CI: 1.00, 1.23)
Sands et al. (2022)[6]	2011-2014	New Jersey, US	Cohort	General population (≥ 65 years)	909	FEMA-designated, storm surge and damaged houses level	Hurricane Sandy	4 years	Participants without exposure	Cardiovascular disease, diabetes, arthritis, and lung disease incidence	Cox proportional hazard model	No significant change

Cortes et al. (2022)[7]	2015-2019	Puerto Rico, US	Cross sectional	General population (≥18 years)	24,555	Self-administered questionnaire	Hurricane Maria	about 2 years	1-year period prior to exposure	General health status, overweight, depression, diabetes	Logistic regression	No significant elevated risk for worse general health status, overweight, depression, diabetes
Harville et al. (2022)[8]	2017-2019	Florida, US	Time series	Pregnant women	436,869	Federal Emergency Management Agency-designated	Hurricane Michael	1 year	1-year period prior to exposure	Preterm birth, low birth weight, and small for gestational age	Log-binomial regression/ logistic model	Relative risk for preterm birth (0.96, 95% CI: 0.88, 1.05); for low birth weight (1.19, 95% CI: 1.07, 1.32); for small for gestational age (1.11, 95% CI: 1.01, 1.21)
Acosta and Irizarry (2022)[9]	1985-2020	4 jurisdictions in US (Puerto Rico, Louisiana, New Jersey and Florida)	Time series	General population (All Ages)	NA	Cyclone landfall time	Six hurricanes (Hugo, Georges, Maria, Katrina, Sandy, Irma)	12-197 days across different hurricanes	Period prior to cyclone landfall	All-cause mortality	Time-series mixed model	Excess deaths for Hurricane Hugo (94, 95% CI: 24, 163); for Hurricane Georges (1300, 95% CI: 1040, 1,550); for Hurricane Maria 3280, 95% CI: 2890, 3670); for Hurricane Katrina (1570, 95% CI: 1300, 1830); for Hurricane Sandy (195, 95% CI: 48, 342); for Hurricane Irma (1280, 95% CI: 790, 1760)
Hochard et al. (2022)[10]	2006-2012	North Carolina, US	Cross sectional	Pregnant women	> 700,000 births	Hurricane declaration date	Hurricane Irene	40 weeks	Births within 5-year period prior to the hurricane	Birth weight, gestation length, preterm birth, low birth weight	Linear (probability) model	β for birth weight (12.7g, 95% CI: 5.4, 20.0); for gestation lengths (-0.10 weeks, 95% CI: -0.14, -0.07); for low birth weight incidence (0.56, 95% CI: 0.22, 0.90); for preterm birth incidence (0.96, 95% CI: 0.53, 1.38)
Li et al. (2022)[11]	2015-2019	Guangzhou, China	Time series	General population (All Ages)	7916	Cyclone-related windspeed; duration of the tropical cyclone with a level 7 wind circle (the average wind speed within the circle was above 13.9–17.1 m/s)	9 TCs	4 weeks	Non-cyclone days	Dengue	Quasi-Poisson regression with distributed lag models	Relative risk (2.13, 95% CI: 1.28, 3.56)

Parayiwa et al. (2022)[12]	2008-2018	Queensland, Australia	Cross sectional	Pregnant women	647, 634 births	Disaster declaration	3 TCs (cyclones Yasi, Marcia and Debbie)	NA	Births in non-affected area	Preterm birth, low birth weight, and small for gestational age	Logistic mixed-effects regression model	Odds ratio for preterm birth associated with cyclone exposure during early pregnancy (1.26, 95% CI: 1.11, 1.43), no significant change for exposure during other trimesters; No significant change for risk of low birth weight associated with cyclone exposure during all trimesters
Bell et al. (2021)[13]	2004-2012	US	Case-crossover	General population (≥ 65 years)	3,629,637	FEMA-designated	8 large-scale hurricanes	30 days	Non-exposure days within the same year of exposure	All-cause hospitalizations	Conditional Poisson regression model	A 10%-23% increase in admission rate after exposure
Weinberger et al. (2021)[14]	2005-2014	New York City, US	Time series	General population (All Ages)	34,767,711	Cyclone hit time	Hurricane Sandy	7 days	Non-cyclone days	Cause-specific ED visits	Quasi-Poisson regression with distributed lag model	Relative risks for aged ≥65 years: All-cause ED visits (1.11, 95% CI: 1.07, 1.16); ED visits due to injuries and poisoning (1.19, 95% CI: 1.10, 1.28); respiratory disease (1.35, 95% CI: 1.21, 1.49); cardiovascular disease (1.10, 95% CI: 1.02, 1.19), renal disease (1.44, 95% CI: 1.22, 1.72); skin and soft tissue infections (1.20, 95% CI: 1.03, 1.39);no significant change for gastrointestinal diseases after the storm Relative risks for aged 18–64 years: ED visits for renal disease (2.15, 95% CI: 1.79, 2.59); no significant change for the all-cause ED or ED visits due to other causes after the storm Relative risks for aged 0–17 years:

												No significant elevated risks for the all-cause ED or cause-specific ED visits
Cowan et al. (2021)[15]	2010-2011	North Carolina, US	Time series	General population (All Ages)	39,688	FEMA-designated	Hurricane Irene	30 days	Same month in previous year	Asthma-related ED visits	Difference in differences with Poisson regression model	No significant change
McCann-Pineo et al. (2021)[16]	2013-2016	New York, US	Cross sectional	General population (≥ 18 years)	1,687	Self-administered questionnaire	Hurricane Sandy	1-4 years	Participants with lower hurricane exposure scores	Opioid abuse	Multinomial logistic regression model	Odds ratio for being classified as high risk of opioid abuse (1.09, 95% CI: 1.05, 1.14)
Zacher et al. (2021)[17]	2003-2018	New Orleans, US	Cohort	Adult women (≥ 18 years)	276	Cyclone hit time	Hurricane Katrina	1 year	8-month period prior to exposure	Physical symptoms (headaches or migraines, back problems, digestive problems)	Logistic regression model	No significant change
Li et al. (2021)[18]	2013-2018	the Pearl River Delta, China	Case-crossover	General population (All Ages)	47,784	Beaufort scale from the yearbook (from the date of near gale-force wind speed ≥ 28 knots to the date when tropical cyclones left or disappeared in the region)	20 TCs	9 days	Same days of week in the same calendar month	Dengue fever	Conditional Poisson regression model	Relative risk for dengue fever (1.31, 95% CI: 1.18, 1.45)
Bozick (2021)[19]	2017-2018	Houston, US	Cross sectional	General population (≥ 18 years)	5,694	Cyclone hit time	Hurricane Harvey	About 6 months	Participants without exposure	Days a month of poor physical or mental health	Negative binomial regression model	An increase of 1.12 days a month of poor physical health and an increase of 1.31 days a month of poor mental health after cyclone
Meir et al. (2021)[20]	2004-2008	five states in US	Cohort	Pregnant women (≥ 18 years)	451,848	FEMA-designated	Hurricane Katrina	About 3 years	about 1-year period prior to exposure	Preterm birth, birth weight, miscarriage rate and infant sex ratio	Generalized estimating equations	No significant change
Parks et al. (2021)[21]	1999-2014	US	Case-crossover	General population (≥ 65 years)	69,682,674	Wind field model (maximum sustained windspeeds of gale force or higher ≥ 17.4 m/s)	All TCs hit US between 1999–2014	7 days	All non-exposure days	Cause-specific hospitalizations	Conditional quasi-Poisson regression model	Relative (percentage) changes for respiratory diseases (14.2%; 95% CI: 10.9%, 17.9%); infectious and parasitic diseases (4.3%; 95%CI:

												1.2%, 8.1%); and injuries (8.7%; 95%CI: 6.0%, 11.8%)
Yan et al. (2021)[22]	1999-2010	US	Case-crossover	General population (≥ 65 years)	NA	Wind field model (maximum sustained winds ≥21 m/s)	74 Atlantic-basin TCs	7 days	All non-exposure days	Cardiovascular and respiratory hospitalizations	Generalized linear mixed-effect model	Relative risks for hospitalizations due to cardiovascular diseases (1.03, 95% CI: 1.02, 1.05); acute myocardial infarction (1.05, 95% CI: 1.00, 1.10); heart failure (1.08, 95% CI: 1.04, 1.11); ischemic heart disease (1.03, 95% CI: 1.00, 1.06); no significant change for cerebrovascular disease, heart rhythm disturbance, peripheral vascular disease. Relative risks for hospitalizations due to respiratory hospitalizations (1.16, 95% CI: 1.13, 1.20); asthma (1.20, 95% CI: 1.07, 1.34); COPD (1.31, 95% CI: 1.23, 1.39); respiratory tract infection (1.08, 95% CI: 1.03, 1.12).
Nethery et al. (2021)[23]	1999-2015	US	Time series	General population (≥ 65 years)	NA	Wind field model (maximum sustained windspeeds of gale force or higher ≥ 17.4 m/s)	53 TCs	11 days	129-day period prior to exposure	All-cause mortality and cardiovascular- and respiratory-related hospitalization	Machine learning approach	Average excess rate for respiratory hospitalizations (8.58, 95% CI: 4.34, 11.86); COPD hospitalizations (4.57, 95% CI: 2.13, 6.79); CVD hospitalizations (-5.01, 95% CI: -9.87, -0.30); no significant change for mortality
de Oliveira et al. (2021)[24]	2001-2005	Santa Catarina, Brazil	Cohort	Newborns	53,006	Cyclone track (within a 100km buffer)	Hurricane Catarina	about 9 months	Babies born within a about 16-month period prior to exposure	Birth weight, low birth weight, high birth weight, short gestational length, long gestational	Difference-in-difference-in-differences	β for birth weight (-44g, 95% CI: -85, -4); for fetal death rate (16.7, 95% CI: 4.6, 28.9); no significant change for other birth outcomes

										length, Apgar score, fetal mortality		
Dosa et al. (2020)[25]	2015-2017	Florida, US	Cohort	General population (≥ 65 years)	123,377	Cyclone track	Hurricane Irma	90 days	Participants without exposure	All-cause mortality and hospitalizations	General estimation equations	Odds ratio for first hospitalization (1.09, 95% CI: 1.05, 1.13); for mortality (1.12, 95% CI: 1.05, 1.18)
Kanaoka et al. (2020)[26]	2012-2016	Japan	Case-crossover	General population (≥ 20 years)	5,643	Cyclone landfall time	Six cyclones (maximum surface wind speeds exceeding 34 knots)	2 days	1-year period prior to exposure	Takotsubo syndrome hospitalization	Conditional Poisson regression model	Incidence rate ratio for takotsubo syndrome hospitalization (1.85, 95% CI: 1.07, 3.19)
Sun et al. (2020)[27]	1989-2002	US	Case-crossover	Pregnant women	19,529,748	Wind field model (sustained wind speed > 17.2 m/s); cumulative rainfall >100 mm; distance to storm track <60 km	58 TCs	30 days	Four randomly selected non-TC days for each county	Preterm birth	Distributed lag log-linear mixed-effects model	Relative risks for preterm birth (1.04, 95% CI: 1.02, 1.06)
Schwartz et al. (2019)[28]	2013-2016	Manhattan, New York and Long Island, US	Cross sectional	General population (≥ 18 years)	2,767	Self-administered questionnaire	Hurricane Sandy	32 months	Participants with smaller number of hurricane exposures	PTSD	Logistic regression model	Odds ratio for likely PTSD symptoms in three study areas (1.25-1.61)
An et al. (2019)[29]	2004-2006	US	Cross sectional	General population (≥ 18 years)	70,267	Level of natural disaster-related damages based on the CoreLogic Hazard Risk Score	Hurricane Katrina	15 months	1.5-year period prior to exposure	Poor mental health days	Difference-in-differences analysis with linear regression	An average of 0.68 increased days of poor mental health
Quast et al. (2019)[30]	2004-2014	Louisiana, Mississippi, Texas, Alabam, US	Cohort	Diabetics (>65 years)	340,656	FEMA-designated	Hurricane Katrina and Rita	1 year, more than 9 year	Participants without exposure	Cause-specific mortality	Conditional logit regression model	Odds ratio for all-cause mortality (1.10, 95% CI: 1.08, 1.12) in more than 9 year after cyclone; for nephritis mortality (1.15, 95%CI: 1.10 1.19) in 1 year after cyclone; No significant change for heart disease and diabetes mortality

Cruz-Cano and Mead (2019)[31]	2008-2017	Puerto Rico, US	Time series	General population (All ages)	118	Cyclone landfall time	Hurricane Maria	40 days	9-year period prior to exposure	Cause-specific mortality	Auto-regressive integrated moving-average model	Relative risk for all-cause mortality (1.25, 95% CI: 1.13, 1.40); for heart disease mortality (1.29, 95% CI: 1.12, 1.53); for diabetes mortality (1.41, 95% CI: 1.15, 1.84); for Alzheimer's disease mortality (1.32, 95% CI: 1.10, 1.68); for Septicemia mortality (1.70, 95% CI: 1.20, 2.84)
Kontoyiannis et al. (2019)[32]	2016-2018	Houston, Texas, US	Time series	Immuno-compromised patients	460	FEMA-designated	Hurricane Harvey	1 year	12-month period before exposure	Mold infections	Ordinary least squares regression lines	No significant increase in hospitalizations due to mold infections
Lawrence et al. (2019)[33]	2007-2014	New York State, US	Time series	General population (≥ 65 years)	651858	FEMA-designated	Hurricane Sandy	1 year	5-year period prior to exposure	Cardiovascular disease, respiratory disease, injury visits/admissions	Poisson regression model	Relative risk for cardiovascular disease (2.01, 95% CI: 2.00, 2.01); for respiratory disease (2.04, 95% CI: 2.04, 2.05); for injury (2.43, 95% CI: 2.43, 2.44)
Ekperi et al. (2018)[34]	2011-2013	Eastern US	Time series	General population with privately insured (All ages)	NA	Cyclone landfall time	Hurricane Sandy	58 weeks	95-week period prior to exposure	HIV testing rate	Interrupted time series analyses	5%-24% decline for HIV testing rates across areas with different level of impacts
Van Loenhout et al. (2018)[35]	2013	Eastern Visayas, Philippines	Cohort	General population (All ages)	2120	Cyclone landfall time	Typhoon Haiyan	3 weeks	1-week period prior to exposure	Cause-specific hospitalizations	Logistic regression model	Odds ratio for "hospitalizations for pregnancy, childbirth and the puerperium" (0.4, 95% CI: 0.3, 0.6); "hospitalizations for certain infectious and parasitic diseases" (2.1, 95% CI: 1.2, 3.5); "hospitalizations for respiratory disease" (1.8, 95% CI: 1.0, 3.0)
Kim et al. (2017)[36]	2008-2013	New Jersey, US	Time series	General population (≥ 76 years)	NA	Municipality-level score combining electricity outages, residential and commercial damage, and	Hurricane Sandy	3 months	2-year period prior to exposure	Cause-specific mortality	Negative binomial regression model	Relative risk for all-cause mortality (1.07, 95% CI: 1.05, 1.10); for cardiovascular mortality (1.06,9 5% CI: 1.02, 1.10); for noninfectious

						emergency assistance						respiratory mortality (1.24, 95% CI: 1.15, 1.33); for infectious disease mortality (1.20, 95% CI: 1.12, 1.29); for unintentional injury–related (1.23, 95% CI: 1.05, 1.44).
Bromet et al. (2017)[37]	2012-2013	Long Island, US	Cohort	Workers in World Trade Center	870	Self-administered questionnaire	Hurricane Sandy	6 months	Participants who claim to be less affected by the hurricane	PTSD, major depressive disorder	Logistic regression model	Odds ratio ranged from 1.77 to 5.38 for PTSD and from 1.58 to 4.13 for major depressive disorder
Grabich et al. (2017)[38]	2003-2004	Florida, US	Ecological	Pregnant women	382,700	Cyclone landfall time	4 hurricanes (Charley, Frances, Ivan, and Jeanne)	3 months	Pregnant women during the same calendar date over 1-year period prior to cyclone	County-level low birth weight, fetal death, and birth rate	Difference-in-differences analysis with linear regression	No significant change
Zheng et al. (2017)[39]	2005-2011	Southeast China	Time series	General population (All ages)	NA	Days of a TC with wind velocity ≥ 13.9 m/s passed the city with following meteorological conditions [24h total rainfall (≥25 mm) or gust wind speed (≥13.9 m/s) or maximum wind speed (≥ 10.8 m/s)]	65 TCs	1 day	Non-TC day	Infectious diseases	$\chi 2$ test	Relative risk for water-food transmitted disease (0.23-14.33); for air transmitted disease (0-144.38); for mosquito transmitted disease (0.33-34.38); for contact transmitted disease (0.18-60.00)
Schwartz et al. (2017)[40]	2013-2014	New York City and Long Island, US	Cohort	Adults (≥ 18 years)	130	Self-administered questionnaire	Hurricane Sandy	about 2-3 year	Participants who claim to be less affected by the hurricane	Anxiety, depression and PTSD	Logistic regression model	Odds ratio for PTSD (1.6, 95% CI: 1.2, 2.2); no significant change for anxiety or depression
Sharp et al. (2016)[41]	2010-2013	New York, US	Time series	General population (All ages)	826,209	Cyclone hit date and model-estimated storm-surge area	Hurricane Sandy	1 year	2-year period prior to exposure	All-cause hospitalizations, outpatient and ED visits for mental illness	Negative binomial regression model	Odds ratio for mental illness-ED visits (1.10 95% CI: 1.07, 1.13); no significant change for all-cause hospitalization and mental illness-outpatient visits
Dresser et al. (2016)[42]	1960-2011	16 Small, Low-Income Countries in in the Caribbean and Central America	Ecological	General population (All ages)	NA	Cyclone track within 200 km of a nation's reference location	149 high-amplitude storms (Saffir-Simpson category 4 or 5)	NA	All non-exposure period	Country-level mortality rate	Generalized estimating equations with negative binomial regression model	Excess death per 10,000 people ranged from 0.15-25.93 among countries with different GDP level and cyclones with different amplitudes

Schwartz et al. (2016)[43]	2013-2015	New York, US	Cross sectional	General population (≥ 18 years)	407	Self-administered questionnaire	Hurricane Sandy	1.5-2 years	Participants who claim to be less affected by the hurricane	Depression, anxiety, PTSD	Logistic regression model	Odds ratio for PTSD (1.26, 95% CI: 1.11, 1.43); no significant change for depression and anxiety
Marshall et al. (2016)[44]	2009-2013	New Jersey, US	Case-crossover	General population (18-65 years)	414,226	Community hardship index of storm impact	Hurricane Sandy	1 year	1-year period prior to exposure	Work-related injuries	Poisson regression model	No significant change
Deng et al. (2015)[45]	2005-2011	Zhejiang, China	Case-crossover	General population (All ages)	NA	NA	3 tropical storms (maximum average windspeed of the cyclone center 17.2 m/s–24.4 m/s); 4 severe typhoons (≥ 41.5 m/s)	7 days for bacillary dysentery, 14 days for other infectious diarrheal disease	7 and 14 days before the first onset of case reports for bacillary dysentery and other infectious diarrheal disease, respectively	Infectious diarrhea	Conditional logistic regression model	Odds ratio for bacillary dysentery and other infectious diarrhea (ranged from 2.30 - 3.56)
Wang et al. (2015)[46]	2009	Guangdong, China	Time series	General population (All ages)	1163	Cyclone landfall time	Typhoon Koppu	NA	Two-weeks period prior to and after the cyclone landing period	Infectious diarrhea	None	No significant change for dysentery, slightly increase for other infectious diarrhea (Rate ratio, 1.10; 95% CI, 1.00, 1.20)
Tian and Guan (2015)[47]	2001-2008	Louisiana, US	Quasi-experiment	Displaced students in public schools	681,753	Evacuee time	Hurricane Katrina	1 year	Non-evacuees	Behavioral disorder	Difference-in-differences analysis with linear probability model	7.3% increase in relative likelihood of any discipline infraction after exposure
Antipova and Curtis (2015)[48]	1991-1995	Louisiana, US	Time series	Pregnant women	34,622	Cyclone track with 20 miles buffer	Hurricane Andrew	3 years	10-month period prior to exposure	Preterm, low birth weight births	$\chi 2$ test	Odds ratio for preterm (1.43, 95% CI: 1.26, 1.62); no significant change for low birth weight
Swerdel et al. (2014)[49]	2007-2012	New Jersey, US	Time series	General population	17,593,658	Cyclone landfall time	Hurricane Sandy	1 month	1-year period prior to exposure	Incidence and mortality of myocardial infarction, strokes	Poisson regression model	Relative risk for myocardial infarction incidence (1.22, 95% CI: 1.16, 1.28); myocardial infarction mortality (1.31, 95% CI: 1.22, 1.41); stroke incidence (1.07, 95% CI: 1.03, 1.11); no significant change in stroke mortality

Kim et al. (2013)[50]	2003-2009	South Korea	Time series	General population (All ages)	23,966	NA	3 typhoons	7 days	Non-exposure period	All-cause mortality, infectious diarrhea hospitalization	None	Relative risk for mortality (1.04, 95% CI: 1.01, 1.07) and for infectious diarrhea (1.07, 95% CI: 1.03, 1.12)
Frahm et al. (2013)[51]	2004-2005	Florida, US	Cohort	Veterans (mean of 59 years)	153,511	Cyclone track	13 hurricanes impacted Florida counties	1 month	Participants without hurricane exposure	Mental health service visits	t test	28 % increase in use of mental health services
Fullerton et al. (2013)[52]	2004-2005	Florida, US	Cross sectional	Public health workers	2,249	Cyclone track and Self-administered questionnaire	5 cyclones	9 months	Participants who claim to be less affected by the hurricane	PTSD	Logistic regression model	Odds ratio (3.21, 95% CI: 2.04, 5.08)
Lin et al. (2013)[53]	2000-2008	Taiwan	Time series	General population (All ages)	23,906	Cyclone track	22 TCs (typhoons)	5 days	Non-typhoon days	All-cause ED visits	Linear regression model	β (2.01, 95% CI: 0.62, 3.39)
Howard et al. (2012)[54]	2001-2005	Gulf Coast, US	Cohort	Dialysis patients	8,718	Cyclone hit time	Hurricane Katrina	1 month	4-year period prior to exposure	Cause-specific hospitalizations	Cox proportional hazard model	Rate ratio for all-cause hospitalization (1.16, 95% CI: 1.05, 1.29); for renal-related hospitalizations (2.53, 95% CI: 2.09, 3.06); no significant change for surgical hospitalizations or medical hospitalizations
Mills et al. (2012)[55]	2005-2006	Gulf Coast, US	Cross sectional	General population (≥ 18 years)	747	Self-administered questionnaire	Hurricane Katrina	1 year	NA	PTSD	Logistic regression model	Odds ratio (1.69, 95% CI: 1.22, 2.33)
Panda et al. (2011)[56]	2007-2009	West Bengal, India	Ecological	General population (≤ 55 years)	65,186	Cyclone hit time	Cyclone Aila	1 month	2-year period prior to exposure	Diarrhoea	$\chi 2$ test	Odds ratio in in two subdivisions (1.6 and 1.3 respectively; 95% CI 1.52, 1.65 and 1.21, 1.32)
Dosa et al. (2010)[57]	2003-2005	Louisiana and Mississippi, US	Ecological	General population (> 65 years)	28,540	Warning zone at 24 hours before landfall by National Weather Service	Hurricane Katrina	90 days	Residents residing at the same facilities one year or two year before hurricane exposure (2003 and 2004)	Mortality and hospitalization rate	$\chi 2$ test	3% increase for mortality rate, 2.6% increase for hospitalization rate after cyclone
Zahran et al. (2010)[58]	1991–1997	US	Cohort	Pregnant women	1,508,927	Cyclone landfall time	Hurricane Andrew	NA	Participants without hurricane exposure	Fetal distress	Logistic regression model	27%-46% increased fetal distress risk associated with hurricane exposure during pregnancy
Kutner et al. (2009)[59]	2003-2006	Louisiana, Mississippi, Alabama, US	Cohort	Dialysis patients (mean age: 61 years)	7,269	Cyclone track	Hurricane Katrina	6 months	Patients without hurricane exposure	All-cause mortality	Cox proportional hazard model	No significant change

Burton et al. (2009)[60]	2004-2007	New Orleans, US	Cohort	General population (≥ 65 years)	20,612	Cyclone hit time	Hurricane Katrina	1 year	1-year period prior to exposure	All-cause mortality and morbidity score	t test	No significant change for mortality rate, 12.6% increase for overall morbidity score
Tees et al. (2009)[61]	2006-2007	New Orleans and Baton Rouge, US	Cohort	Pregnant women (≥ 18 years)	288	Self-administered questionnaire	Hurricane Katrina	1 year	Participants who claim to be less affected by the hurricane	Infant temperament	Logistic regression model	No significant change
Fonseca et al. (2009)[62]	2005-2006	New Orleans, US	Cohort	Individuals with diabetes (≥ 18 years)	1,795	Cyclone hit time	Hurricane Katrina	6-16 months	6-month period prior to hurricane	Level of A1C, blood pressure, and lipids	t test	0.1% increase in A1C; 10.5 and 3.9 mmHg increase in SBP and DBP; 6.0 mg/dl increase in LDL; 2.4 mg/dl decrease in HDL; no significant change for triglycerides
Anastario et al. (2009)[63]	2006-2017	Mississippi, US	Cross sectional	Women (mean of 42 years)	420	Cyclone hit time	Hurricane Katrina	2 years	1-year period after exposure	Gender-based violence	t test	3.2% increase in recent gender-based violence prevalence
Harville et al. (2009)[64]	2005-2007	New Orleans and Baton Rouge, US	Cohort	Pregnant women (≥ 18 years)	292	Phone interview	Hurricane Katrina	8–10 weeks	Participants with less experiences of Hurricane	Depression, PTSD	Loglinear/Poisson regression	Relative risk for depression (1.77, 95% CI: 1.08, 2.89) and PTSD (3.68, 95% CI: 1.80, 7.52) associated with two or more severe experiences of the hurricanes
Xiong (2008)[65]	2006-2007	Louisiana, US	Cohort	Pregnant women	301	Self-administered questionnaire	Hurricane Katrina	about 21 months	Participants who claim to be less affected by the hurricane	Low birth weight, preterm birth	Logistic regression model	Odds ratio for low birth weight: (3.3, 95% CI: 1.13, 9.89); preterm birth: (2.3, 95% CI: 0.82, 6.38)
Kessler et al. (2006)[66]	2001-2005	Alabama, Louisiana and Mississippi, US	Cross sectional	General population (> 18 years)	1,869	Cyclone hit time	Hurricane Katrina	1 month	Patients without hurricane exposue	Mental health, suicidality	Logistic regression model	Odds ratio for any mental illness (2.4, 95% CI: 1.8–3.2); no significant change in suicide rates
Fried et al. (2005)[67]	1998-2000	North Carolina, US	Time series	General population (All ages)	NA	FEMA-designated	Hurricane Floyd	1 year	14 months prior to exposure	Mental health visits	Difference-in-differences analysis with linear regression	β for number of outpatient visits to psychologists/or licensed clinical social workers (0.0007, SE: 0.00015)
Keenan et al. (2004)[68]	1998-2001	North Carolina, US	Ecological	Children (≤ 24 months)	245	Federal disaster declaration together with drowning-related deaths	Hurricane Floyd	6 months	1-year period prior to exposure	Traumatic brain injury	Poisson regression model	Rate ratio for inflicted traumatic brain injury (5.1, 95% CI: 1.3, 20.4), non-inflicted traumatic brain injury (10.7, 95% CI: 2.0, 59.4)
Sanders et al. (1999)[69]	1996	Puerto Rico, US	Case-control	Dengue-negative	142	Cyclone hit time	Hurricane Hortense	24 days	34 days prior to exposure	Leptospirosis	None	Relative risk (4.4, 95% CI: 1.6, 12.4)

				patients (13-64 years)								
Hendrickson et al. (1997)[70]	1992	Kauai, US	Time series	General population (All ages)	1,815	Cyclone hit time	Hurricane Iniki	2 weeks	2-week prior to exposure	Injury, cardiovascular and asthma-related physician visits	None	Relative risk for injury (6.86, 95% CI: 5.98, 7.87); for cardiovascular complaints (2.73, 95% CI: 1.51, 4.94); for asthma (2.81, 95% CI: 1.93, 4.09)
Hendrickson and Vogt (1996)[71]	1987-1992	Kauai, US	Time series	General population (All ages)	736	Cyclone hit time	Hurricane Iniki	1 year	5-year period prior to exposure	Cause-specific mortality	None	Relative risk for diabetes mortality (2.61, 95% CI: 1.44, 4.74); no significant change for mortality due to heart disease, stroke, cancer, injury and respiratory diseases
Garrison et al. (1993)[72]	1990	South Carolina, US	Cross sectional	High school students (11-17 years)	1,264	Self-administered questionnaire	Hurricane Hugo	1 year	Participants who claim to be less affected by the hurricane	PTSD	Logistic regression model	Odds ratio (1.26, 95% CI: 1.13, 1.41)

Abbreviations: A1C, glycemic control; CI, confidence interval; COPD, chronic obstructive pulmonary disease; CrI, credible interval; DBP, diastolic blood pressure; ED, emergency department; FEMA, Federal Emergency Management Agency; HDL, high-density lipoprotein; LDL, low-density lipoprotein; NA, not available/not applicable; PTSD, post-traumatic stress disorder; SBP, systolic blood pressure; TC, tropical cyclone.

*Model used in the study to derive the effect estimates

Table S4: Heat map for risk of bias rating and quality rating for the included studies

Study	Risk of Bias							
	Key Criteria			Other Criteria				
	Exposure assessment	Outcome assessment	Confounding bias	Selection bias	Attrition/exclusion bias	Selective reporting bias	Conflict of interest	Other source of bias
Begum et al. (2022)[2]	2	1	2	3	2	2	2	2
Parks et al. (2022)[3]	2	1	1	1	2	1	3	2
Bell et al. (2022)[4]	3	1	2	3	2	3	1	2
Quist et al. (2022)[5]	3	1	2	2	2	1	2	1
Sands et al. (2022)[6]	3	1	2	2	1	3	1	2
Cortes et al. (2022)[7]	2	3	2	3	2	3	1	2
Harville et al. (2022)[8]	2	1	2	1	2	2	1	2
Acosta and Irizarry (2022)[9]	2	1	1	1	1	1	1	1
Hochard et al. (2022)[10]	3	1	2	1	1	2	1	2
Li et al. (2022)[11]	2	1	2	1	2	1	1	1
Parayiwa et al. (2022)[12]	3	1	2	1	2	2	1	2
Bell et al. (2021)[13]	3	1	2	3	2	1	1	2
Weinberger et al. (2021)[14]	2	1	2	1	2	2	3	1
Cowan et al. (2021)[15]	2	1	2	1	2	1	3	2
McCann-Pineo et al. (2021)[16]	2	2	3	3	1	1	1	3
Zacher et al. (2021)[17]	3	2	1	4	1	2	1	2
Li et al. (2021)[18]	2	1	2	1	2	1	1	2
Bozick (2021)[19]	2	3	2	3	1	2	1	2
Meir et al. (2021)[20]	3	2	3	2	2	1	1	2

Parks et al. (2021)[21]	1	1	2	1	2	1	1	1
Yan et al. (2021)[22]	1	1	2	1	2	1	1	1
Nethery et al. (2021)[23]	2	1	2	1	1	2	1	2
de Oliveira et al. (2021)[24]	3	1	2	1	2	2	3	2
Dosa et al. (2020)[25]	3	1	2	1	1	2	3	2
Kanaoka et al. (2020)[26]	2	1	2	1	3	1	1	2
Sun et al. (2020)[27]	1	1	2	1	2	1	3	1
Schwartz et al. (2019)[28]	2	1	1	3	2	1	3	2
An et al. (2019)[29]	3	1	1	2	3	2	1	2
Quast et al. (2019)[30]	3	1	2	2	3	3	1	2
Cruz-Cano and Mead (2019)[31]	2	1	2	1	2	3	1	2
Kontoyiannis et al. (2019)[32]	2	1	3	1	2	1	3	3
Lawrence et al. (2019)[33]	2	1	2	1	2	2	1	2
Ekperi et al. (2018)[34]	2	2	2	3	2	1	1	1
Van Loenhout et al. (2018)[35]	3	1	3	1	2	1	1	2
Kim et al. (2017)[36]	2	1	2	1	2	1	3	2
Bromet et al. (2017)[37]	2	1	1	1	2	1	3	2
Grabich et al. (2017)[38]	3	1	2	1	1	3	3	2
Zheng et al. (2017)[39]	2	1	4	1	2	1	1	3
Schwartz et al. (2017)[40]	2	1	1	3	2	1	1	2
Sharp et al. (2016)[41]	2	1	2	1	1	2	3	2
Dresser et al. (2016)[42]	3	2	2	1	2	1	3	2
Schwartz et al. (2016)[43]	2	2	1	3	1	1	3	2

Marshall et al. (2016)[44]	2	1	2	2	2	1	3	2
Deng et al. (2015)[45]	2	1	2	1	2	1	1	2
Wang et al. (2015)[46]	2	1	3	1	2	1	3	3
Tian and Guan (2015)[47]	3	1	2	1	2	1	1	2
Antipova and Curtis (2015)[48]	2	1	4	1	2	1	3	3
Swerdel et al. (2014)[49]	2	1	2	2	2	1	1	2
Kim et al. (2013)[50]	3	1	4	2	2	2	1	2
Frahm et al. (2013)[51]	3	1	3	1	2	1	3	3
Fullerton et al. (2013)[52]	2	1	1	1	2	2	1	1
Lin et al. (2013)[53]	3	1	2	1	2	1	3	2
Howard et al. (2012)[54]	2	1	2	3	2	1	3	2
Mills et al. (2012)[55]	2	2	2	2	2	1	3	2
Panda et al. (2011)[56]	2	1	3	1	1	1	3	3
Dosa et al. (2010)[57]	2	1	3	1	1	1	1	3
Zahran et al. (2010)[58]	3	2	1	2	2	1	3	2
Kutner et al. (2009)[59]	3	2	1	2	2	1	1	2
Burton et al. (2009)[60]	3	1	4	2	2	1	1	3
Tees et al. (2009)[61]	2	1	2	2	3	1	1	2
Fonseca et al. (2009)[62]	3	2	4	1	1	2	1	3
Anastario et al. (2009)[63]	3	2	4	2	3	1	1	3
Harville et al. (2009)[64]	2	2	2	3	3	1	1	2
Xiong (2008)[65]	2	2	2	3	1	1	3	2
Kessler et al. (2006)[66]	3	2	4	3	3	1	1	2

Fried et al. (2005)[67]	2	2	2	1	1	1	3	2
Keenan et al. (2004)[68]	2	1	2	2	1	1	3	2
Sanders et al. (1999)[69]	3	1	4	2	1	1	3	3
Hendrickson et al. (1997)[70]	2	1	3	2	2	2	3	3
Hendrickson and Vogt (1996)[71]	2	1	4	1	2	2	3	3
Garrison et al. (1993)[72]	2	2	2	3	1	1	3	2

Risk of bias rating 1 Low 2 Probably low 3 Probably high 4 High

Note: Risk of bias assessment was conducted for each study using adapted criteria based on the National Institutes of Environmental Health Sciences National Toxicology Program Office of Health Assessment and Translation (OHAT) tool[1]. Each of domain was evaluated as “low,” “probably low,” “probably high,” or “high” risk according to specific criteria. See Table S2 for more information on risk of bias ratings.

Table S5: Details of risk of bias assessment for included studies

Study	Risk of Bias ratings, reason							
	Key Criteria			Other Criteria				
	Exposure assessment	Outcome assessment	Confounding bias	Selection bias	Attrition/exclusion bias	Selective reporting bias	Conflict of interest	Other source of bias
Begum et al. (2022)[2]	Probably low Utilized a hurricane period designated by the FEMA to define the cyclone exposure period for the study area and accounted for the persistent exposure, but did not account for the time-varying cyclone exposure	Low Outcome data was obtained from local authorities and defined by standard ICD codes	Probably low Accounted for variables of long-time trend, weekday, weekend, holiday, month, and year in the time-see, but not public holiday	Probably high Included all ED and hospitalizations for mental health issues of older adults in Hurricane Sandy-affected New York State counties, but was not able to adjust for duplicate cases or repeat admissions due to a lack of personal identifiers and only included severe cases while the study's aim was on mental health effects associated with Hurricane Sandy	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Probably low Reported a series of outcomes of self-selected mental health subtypes	Probably low Declared no known competing financial interests	Probably low Time-stratified Poisson regression model was used. Did not test the robustness by sensitivity analysis. No study protocol
Parks et al. (2022)[3]	Probably low Exposure assessment was based on high-resolution wind field model that could account for the persistent and time-varying cyclone exposures, but monthly exposures were used	Low National mortality data in the US data was obtained and outcomes were defined by ICD codes	Low Non-time-varying confounding factors across regions like socioeconomic status, long-term trend, seasonality and temperature were controlled by modelling strategy and a matching design	Low Included 33.6 million deaths in 1206 counties across US that experienced tropical cyclones from 1988-2018	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Low Causes of death were classified into 7 categories that cover all types of death causes, and the results of all of these categories were reported except the invalid category of “other causes” due to the diverse causes in this category	Probably high Declared potential conflict of interests for some authors	Probably low Bayesian conditional quasi-Poisson model was used and the robustness was tested by a series of sensitivity analysis. Inadequate information provided to judege the compliance with study protocol
Bell et al. (2022)[4]	Probably high The cyclone exposure assessment for the study area was only based on a static point-in-time estimate of cyclone hit date at the county level, which did not consider the different length and strength across cyclones, nor did account for the time-	Low Hospitalization data was obtained official authorities and outcomes were defined by ICD codes	Probably low Temporally invariant confounders such as gender and age were controlled for by a self-matched design	Probably high The collected hospitalization data was limited to fee-for-service Medicare beneficiaries aged 65 years and older, Older Americans who are enrolled in Medicare Advantage plans who generally have better	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Probably high Cause-specific hospitalization data was collected, but only four hospitalization outcomes were studied (all-cause hospitalizations and	Low Declared no competing financial interests	Probably low Common conditional Poisson model was used and the robustness was tested by a series of sensitivity analysis. No study protocol

	varying exposures			health outcomes were excluded		hospitalizations for diabetes, COPD, and congestive heart failure)		
Quist et al. (2022)[5]	Probably high The cyclone exposure for the study area was assessed only based on a static point-in-time estimate of cyclone-related flood extent, which did not consider cyclone end date, nor did account for the individual persistent and time-varying cyclone exposures. Additionally, the ZIP code of the billing address of each participant was used to estimate cyclone exposure, which do not identify the ED's location	Low Data was obtained from a public health surveillance system containing records of all civilian ED visits to hospitals in North Carolina and the study outcome was defined by standard ICD codes	Probably low Temporally invariant and variant confounders such as overall sociodemographic factors, healthcare access, and rurality were controlled for by a self-matched design	Probably low Included all ED visits for gastrointestinal illness among all residents in North Carolina, hospitalization and other data types were not included	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Low Focused on ED visits for acute gastrointestinal illness and report all relevant findings	Probably low Declared no known competing financial interests	Low Controlled interrupted time series model was used and a series of sensitivity analyses were used to test the robustness. No study protocol
Sands et al. (2022)[6]	Probably high The cyclone exposure for each individual was assessed based on a static point-in-time estimate of cyclone impacts reflected by storm surge intensity and number of damaged houses, which may not account for the different length and strength of cyclone exposure across individuals accurately, nor did consider the time-varying exposure	Low Outcome and diagnosis dates were derived from the Medicare data	Probably low Included age, sex, marital status, pre-hurricane diagnosis of depression, number of comorbidities, BMI, fear and distress in the model	Probably low Part of the participants without returned questionnaire or valid answers were excluded	Low No outcome data was excluded inappropriately	Probably high Four chronic disease outcomes were selected from the Medicare data and included in the study	Low Declared no competing financial interests	Probably low Cox proportional hazard models was used and test the robustness by a series of sensitivity analyses on different subsamples. No study protocol
Cortes et al. (2022)[7]	Probably low Exposure assessment was based on questionnaire collected from each individual	Probably high Outcomes were assessed based on self-reported questionnaire without a valid diagnosis	Probably low Included age, sex, race, education, employment, income, marital status in the model	Probably high Included a representative sample of resident adults in Puerto Rico, but the response rates were relatively low (about 50%)	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Probably high Part of the measured outcomes were included in the study	Low Declared no competing financial interests	Probably low Common logistic regression was applied test the robustness by a series of sensitivity analysis on different subsamples. No study protocol

Harville et al. (2022)[8]	Probably low The exposed period for the study area was defined as 12 months after the Hurricane Michael hit date and unexposed period was defined as the 12 months before the Hurricane Michael hit date, while did account for time-varying cyclone exposures.	Low Outcome data were derived from the local authorities and were defined based on well-established standard	Probably low Included maternal age, race, education, and whether enrolled in the special supplemental nutrition program in the model	Low Included all births from the state of Florida occurring in the year before and after the date of the hurricane	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Probably low Main adverse birth outcomes including preterm birth, low birth weight, and small for gestational age were included and reported	Low Declared no competing financial interests	Probably low Common log-binomial regression/logistic models were applied, and the robustness was tested by a series of sensitivity analysis on different set of adjusted confounders. No study protocol
Acosta and Irizarry (2022)[9]	Probably low Exposure assessment was based on high-resolution wind field model that could account for the persistent and time-varying cyclone exposures, but only used cyclone start date	Low Mortality data was obtained from official authorities and all-cause mortality was used as the outcome	Low Adjusted a series of confounders including age, secular trends, seasonal and day of the week effects, population size, and natural variation	Low All mortality data in the study areas was obtained during the study period	Low No outcome data was excluded inappropriately	Low Focused on all-cause mortality and reported all relevant findings	Low Declared no competing financial interests	Low Advanced model with high statistical power was applied, complemented with a series of simulation analyses to test the robustness. No study protocol
Hochard et al. (2022)[10]	Probably high The cyclone exposure for each individual was assessed based on a static point-in-time estimate of cyclone impacts as reflected by cyclone-related damage level, which may not account for the different length and strength of cyclone exposure across individuals accurately, nor did consider the time-varying exposure	Low Birth records were derived from the local authorities and were defined based on well-established standard	Probably low Accounted for local neighbourhood characteristics, long-term trend and seasonality effects in the model	Low All officially recorded births in North Carolina was obtained for the study period	Low No outcome data was excluded inappropriately	Probably low Main adverse birth outcomes including preterm birth and low birth weight were included and reported	Low Declared no competing financial interests	Probably low Linear (probability) model was applied to assess the treatment effects of cyclone exposure, complemented with a series of sensitivity analyses to test the robustness. No study protocol
Li et al. (2022)[11]	Probably low Continuous cyclone exposure was assessed by including the information on the generation and disappearance date, path, landing location, and wind speed of the cyclones to account for the persistent and time-varying cyclone exposures. However, the exposure level was at the centroid of the cyclone and	Low Dengue cases were obtained from the official surveillance system and were diagnosed by professional medical institutions	Probably low Adjusted long-term trend, seasonality, temperature, cumulative precipitation and average relative humidity	Low All officially recorded dengue cases in Guangdong was obtained for the study period	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Low Focused on dengue incidence and reported all relevant findings	Low Declared no competing financial interests	Low Utilized well-established and standard time-series analysis with quasi-Poisson generalized linear model combined with a distributed lag non-linear model, complemented with a series of sensitivity analyses to test the

	no wind field model was applied to quantify the exposure level at each location							robustness. No study protocol
Parayiwa et al. (2022)[12]	Probably high The cyclone exposure for each individual was assessed based on a static point-in-time estimate of cyclone impacts reflected by damage level, which did not account for the different strength and length across cyclones and exposure level and length across individuals. Additionally, the exposure was assessed at large government-based spatial unit level	Low Birth records were derived from the local authorities and were defined based on well-established standard	Probably low Adjusted maternal age, marital status, maternal identification, infant sex, smoking during pregnancy, socioeconomic status, maternal country of birth, remoteness and season of birth	Low All officially recorded births in Queensland was obtained for the study period	Probably low Cases were removed if the mother was not a usual resident of Queensland	Probably low Main adverse birth outcomes including preterm birth, low birth weight, and small for gestational age were included and reported	Low Declared no competing financial interests	Probably low Logistic mixed-effects regression model was applied to assess the treatment effects of cyclone exposure, complemented with a series of secondary analyses to test the robustness. Inadequate information provided to judge the compliance with study protocol
Bell et al. (2021)[13]	Probably high The cyclone exposure was assessed based on a static point-in-time estimate of cyclone hit date, which did not account for the different strength and length across cyclones	Low Hospitalization data was obtained official authorities and all-cause hospitalization was used as the outcome	Probably low Temporally invariant confounders such as gender, and age were controlled for by a self-matched design	Probably high The collected hospitalization data was limited to fee-for-service Medicare beneficiaries aged 65 years and older, Older Americans who are enrolled in Medicare Advantage plans who generally have better health outcomes were excluded	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Low Focused on all-cause hospitalizations and reported all relevant findings	Low Declared no competing financial interests	Probably low Common conditional Poisson model was used and the robustness was tested by a series of sensitivity analyses. No study protocol
Weinberger et al. (2021)[14]	Probably low The exposed period for the study area was defined as 7 days after the Hurricane Sandy hit date and unexposed period was defined as the other days of the study period, while did account for time-varying cyclone exposures.	Low ED visit data was obtained official authorities and the study outcome was defined by standard ICD codes	Probably low The model controlled long-term time trend and seasonality (year, week of year) and day of week	Low All ED visits occurring in the state of New York during the study period were obtained	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Probably low Six outcomes were defined based on ED visits for six major diseases and all relevant findings were reported	Probably high Declared potential conflict of interests for some authors	Low Utilized well-established and standard time-series analysis with quasi-Poisson generalized linear model combined with a distributed lag non-linear model, complemented with a series of secondary analyses to test the robustness. No study protocol
Cowan et al.	Probably low	Low	Probably low	Low	Probably low	Low	Probably	Probably low

(2021)[15]	The exposed period for the study area was defined as 30 days after the Hurricane Irene hit date and unexposed period was defined as the same period in the previous year, while did account for time-varying cyclone exposures	ED visit data was obtained official authorities and the study outcome was defined by standard ICD codes	The model controlled for county, long-term trend (month, year) and accounted for correlation between monthly county rates within the same year using an autoregressive-1 correlation structure	More than 97% of all ED visits in the state of North Carolina were obtained	No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Focused on ED visits for asthma and report all relevant findings	high No declaration of potential conflict of interest found	Difference in differences with Poisson regression was used and the robustness was tested by a series of sensitivity analyses. No study protocol
McCann-Pineo et al. (2021)[16]	Probably low Exposure assessment was based on questionnaire collected from each individual	Probably low The outcome was assessed using adaptations from a widely implemented tool, but this tool had not been currently validated for being used in community samples	Probably high The model in this cross-sectional study only adjusted for insurance status, location of recruitment, and smoking status	Probably high Participants were conveniently sampled from the community	Low No outcome data was excluded inappropriately	Low Focused on risk of opioid abuse and report all relevant findings	Low Declared no competing financial interests	Probably high Multinomial logistic regression was used. Sensitivity analysis like linearity check was not conducted
Zacher et al. (2021)[17]	Probably high The cyclone exposure for each individual was assessed based on a static point-in-time estimate of cyclone hit date, which did not account for the different exposure level and length across individuals	Probably low Self-reported current symptom for each individual	Low The model in this cohort study adjusted a wide range of confounders including age, race, number of children, married or cohabiting status, food stamp receipt, perceived social support, and psychological distress	High Participants were originally recruited for another randomized controlled trial of an intervention to increase retention, but for the aim in current study, and the participants were composed largely of African American mothers	Low No outcome data was excluded inappropriately	Probably low Three physical symptoms were collected and included as outcomes. All relevant findings were reported	Low Declared no competing financial interests	Probably low Logistic regression was used, along with a series of secondary analyses to justify the results
Li et al. (2021)[18]	Probably low Continuous cyclone exposure was assessed based on the path disappearance date, and wind speed of the cyclones. The persistent and time-varying cyclone exposures were considered. However, the exposure level was at the centroid of the cyclone and no wind field model was applied to quantify the exposure level at participants' location	Low Dengue fever infections were obtained from the official surveillance system and were diagnosed by professional medical institutions	Probably low A time-stratified case-crossover design was utilized with control of the long-term trend, seasonality and day of week	Low All officially recorded cases in the study area were obtained for the study period	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Low Focused on dengue fever incidence and reported all relevant findings	Low Declared no competing financial interests	Probably low Utilized well-established and standard time-series analysis with conditional Poisson regression model, complemented with a series of sensitivity analyses to test the robustness. No study protocol
Bozick	Probably low	Probably high	Probably low	Probably high	Low	Probably low	Low	Probably low

(2021)[19]	A separate survey was conducted before the cyclone and after the cyclone was completely over, with those surveyed after the cyclone was completely over serving as the exposed group and those surveyed before the cyclone serving as the control, but did not account for the varying exposure level	Self-developed questions were used for each participant to collect self-reported health conditions, less of quality control procedure	The model adjusted for age, sex, race, education, nativity, income, employment and marital status	Include a randomly selected population sample in Harris County, but the response rates were relatively low (about 33%)	No outcome data was excluded inappropriately	A wide array of questions about health were asked for each individual and were included in the study as outcomes	Declared no competing financial interests	A negative binomial regression model, supplemented by a series of secondary analyses, was used to justify this association. No study protocol
Meir et al. (2021)[20]	Probably high Utilized a hurricane period designated by the FEMA to define cyclone exposure for each individual, which did not account for the different exposure level and length across participants, nor did account for the time-varying exposures	Probably low Despite the outcomes were obtained from an official national database and had been validated, there is still a potential recall bias as they were mainly self-reported by patients to the clinic	Probably high The model adjusted for age, maximum follicle stimulating hormone levels, gravidity, and infertility diagnosis, while did not consider the education and income level	Probably low The database includes the outcome data from 85% of the centres within the US and is prospectively collected by each individual centre	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Low Main adverse birth outcomes including Preterm birth, birth weight, miscarriage rate and infant sex ratio were included and reported with statistically insignificant findings	Low Declared no competing financial interests	Probably low This study used generalized estimating equations to account for the within-patient correlations and used a series of secondary analyses to examine the association. No study protocol
Parks et al. (2021)[21]	Low Cyclone exposure was assessed based on high-resolution wind field model that accounted for the spatially and temporally varying cyclone exposure.	Low Inpatient data was obtained national official authorities and the study outcomes were defined by standard ICD codes	Probably low The model adjusted for day of week, long-term trend and temperature, but not public holiday	Low Hospitalization data from 70 million Medicare hospitalizations across US over a 16-year period was obtained	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Low Included a wide range of 13 CCS level 1 causes that covering almost all death causes	Low Declared no competing financial interests	Low Utilized well-established and standard time-series analysis with conditional quasi-Poisson regression model combined with a distributed lag non-linear model to account for the cumulative and delayed effects of cyclones
Yan et al. (2021)[22]	Low Cyclone exposure was assessed based on high-resolution wind field model that accounted for the spatially and temporally varying cyclone exposure.	Low Emergency Medicare hospital admissions data was obtained national official authorities and the study outcomes were defined by standard ICD codes	Probably low The model adjusted for year, day of week, random intercept of county, but not public holiday	Low All emergency Medicare hospital admissions data was obtained from the eastern half of the US that experienced cyclones	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential	Low Two major diseases (respiratory and cardiovascular diseases) and their subtypes were included in the	Low Declared no competing financial interests	Low Utilized well-established and standard time-series analysis with Poisson regression model combined with a distributed lag non-

					low risk	study.		linear model to account for the cumulative and delayed effects of cyclones
Nethery et al. (2021)[23]	Probably low Cyclone exposure was assessed based on high-resolution wind field model to account for cyclone strength, but only used the cyclone start date and did not account for the cyclone varying length	Low Mortality data was obtained national official authorities and the study outcomes were defined by standard ICD codes	Probably low The model adjusted for the space-time trends (including trends induced by time-varying confounders)	Low All mortality data was obtained across US during the study period	Low No outcome data was excluded inappropriately	Probably low Three major outcomes (all-cause mortality, respiratory and cardiovascular diseases mortality), as well as COPD hospitalizations were selected and included	Low Declared no competing financial interests	Probably low This study developed a new model based on machine learning approach to account for the cyclone-specific effects. A series of sensitivity and secondary analyses were conducted to justify the results. No study protocol
de Oliveira et al. (2021)[24]	Probably high The cyclone exposure for each individual was assessed based on a static point-in-time estimate of cyclone hit date, which may not consider the varying cyclone exposure level and length across individuals accurately, nor did account for the time-varying cyclone exposures	Low Outcome data was obtained national official authorities and the study outcomes were defined using well-established standard	Probably low The model adjusted for a wide range of confounders including year, regional effects, year-specific region effects, season of birth effects, year-specific season of birth effects, region-specific season of birth effects	Low All outcome data were obtained from the study area during the study period	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Probably low A wide range of adverse birth outcomes including birth weight, low birth weight, high birth weight, short gestational length, long gestational length, Apgar score, and fetal mortality were reported	Probably high No declaration of potential conflict of interest found	Probably low Standard difference-in-difference approach was used to assess the cyclone effects. A series of sensitivity and secondary analyses were conducted to justify the results. No study protocol
Dosa et al. (2020)[25]	Probably high The cyclone exposure for each individual was assessed based on a static point-in-time estimate of cyclone hit date, which may not consider the cyclone exposure strength and length across individuals accurately, nor did account for the time-varying cyclone exposures	Low Outcome data was obtained local official authorities and the outcomes only included all-cause mortality and hospitalization	Probably low The study clustered the model by person ID and facility ID to account for within-person and within-facility ID variance. A directed acyclic graph was supplemented to support the analysis assumptions	Low Outcome data were collected quarterly on all participants and are also collected after significant changes in health care status	Low No outcome data was excluded inappropriately	Probably low To major health outcome of all-cause mortality and first Hospitalization were included and all relevant findings were reported	Probably high Declared potential conflict of interests for some authors	Probably low General estimation equations was used to assess the cyclone effects. A series of sensitivity and secondary analyses were conducted to justify the results. No study protocol
Kanaoka et al. (2020)[26]	Probably low	Low	Probably low	Low	Probably high	Low	Low	Probably low

	Continuous cyclone exposure for the study area was defined based on the windspeed data from Meteorological Agency, but did not account for cylone strength	Outcome data was diagnosed by physicians based on standard ICD code	The study adjusted individual-level temporally invariant confounders such as overall sociodemographic status, gender, healthcare access by a self-matched design	Outcome data were collected nationwide and showed a good representativeness	A total of 10 782 patients with Takotsubo syndrome were identified at 834 hospitals, but only 6959 of them who were ≥20 years old and underwent coronary angiography were included in the final analysis	Focused on Takotsubo syndrome and reported all relevant findings	Declared no competing financial interests	In the framework of a self-controlled case series design, standard conditional Poisson regression model was applied to assess the cyclone-related risks. A series of secondary analyses were conducted. Inadequate information provided to judge the compliance with study protocol
Sun et al. (2020)[27]	Low Cyclone exposure was assessed based on high-resolution wind field model that accounted for the spatially and temporally varying cyclone exposure.	Low Outcome data was obtained national official authorities and the study outcomes were defined using well-established standard	Probably low The study adjusted year, day of week, daily expected number of preterm births, country random intercept, but not public holiday	Low Outcome data were collected nationwide and showed a good representativeness	Probably low Though outcome data was collected across the US, but was only available for counties with a population of ≥100,000	Low Focused on preterm birth and reported all relevant findings	Probably high Declared potential conflict of interests for some authors	Low Utilized well-established and standard time-series analysis of distributed lag log-linear mixed-effects models to account for the cumulative and delayed effects of cyclones. No study protocol
Schwartz et al. (2019)[28]	Probably low Exposure assessment was based on cyclone experience collected by self-reported questionnaire collected from each individual	Low Outcome was assessed based on standard and well-established criteria	Low The study adjusted a wide range of confounders including age, gender, race, education, mental health treatment, history of mental health issues, time elapsed between Hurricane Sandy and survey time	Probably high Part of the participants were conveniently sampled from the community	Probably low More than 90% of the participants had complete outcome data	Low Focused on PTSD and reported all relevant findings	Probably high Declared potential conflict of interests for some authors	Probably low Used traditional logistic regression to assess the cyclone-related risks. A series of secondary analyses were conducted. Inadequate information provided to judge the compliance with study protocol
An et al. (2019)[29]	Probably high The cyclone exposure for each individual was assessed based on a static point-in-time estimate of cyclone hit date, which may not consider the varying exposure level and length across individuals	Low Outcome was assessed based on standard and well-established criteria	Low The study adjusted a wide range of confounders including sex, age, race, education, employment status, marital status,	Probably low The participants were from a US state-based system of annually repeated cross-sectional telephone surveys that collect information on health information among US	Probably high More than 20% of the participants were excluded due to incomplete data	Probably low A wide range of mental health indicators were included as outcomes	Low Declared no competing financial interests	Probably low The cyclone-related risks were assessed using standard difference-in-differences analysis with linear regression. A series of secondary

	accurately, nor did account for the time-varying cyclone exposures		pregnancy, annual household income levels, physical activity, BMI, smoking, self-rated physical health, interview month	adults				analyses were conducted. No study protocol
Quast et al. (2019)[30]	Probably high The cyclone exposure for each individual was assessed based on a static point-in-time estimate of cyclone hit date, which may not consider the varying exposure level and length across individuals accurately, nor did account for the time-varying cyclone exposures	Low Mortality data was obtained from official and reliable authorities, and the outcomes were defined based on standard ICD code	Probably low The study adjusted age, gender, race, Medicaid premiums, end-stage renal disease coverage, chronic condition	Probably low Focused on seniors with diabetes, and included a large and representative sample, while these seniors were all Medicare beneficiaries	Probably high Only about half of the study participants were finally included in the analysis after a series of exclusion criteria (e.g., data validity)	Probably high All mortality causes were obtained, while only included and analysed mortality from diabetes, major cardiovascular disease, and nephritis	Low Declared no competing financial interests	Probably low The cyclone-related risks were assessed using conditional logit regressions. A series of secondary analyses were conducted. No study protocol
Cruz-Cano and Mead (2019)[31]	Probably low The exposed period for the study area was defined as about 40 days after the Hurricane Maria hit date and unexposed period was defined as the 9-year period before the Hurricane Maria hit date, while did account for time-varying cyclone exposures	Low Mortality data was obtained from official and reliable authorities, and the outcomes were defined based on standard ICD code	Probably low The study adjusted seasonality, long-term trend and natural variation using a standard time-series analysis of auto-regressive integrated moving-average model	Low All outcome data in the study area during the study period was collected	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Probably high All mortality causes were obtained, while only included and analysed mortality from diabetes, heart disease, Alzheimer's disease and Septicaemia	Low Declared no competing financial interests	Probably low Standard time-series analysis of auto-regressive integrated moving-average model was used. No study protocol
Kontoyiannis et al. (2019)[32]	Probably low The exposed period for the study area was defined as about 12 months after the Hurricane Harvey hit date and unexposed period was defined as the 1-year period before the Hurricane Harvey hit date, while did account for time-varying cyclone exposures	Low Outcome data was obtained from official and reliable surveillance database and the outcomes were defined based on validated criteria	Probably high Seasonality, long-term trend and natural variation were all not accounted for	Low All records to define the outcomes in the study area during the study period was collected	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Low Focused on mold infections and reported all relevant findings	Probably high Declared potential conflict of interests for some authors	Probably high Ordinary least squares regression was used before and after the cyclone period, without any variable adjustment, sensitivity or secondary analysis.
Lawrence et al. (2019)[33]	Probably low Pre-hurricane (unexposed) and post-hurricane (exposed) period for the study area was defined on the basis of the	Low Outcome data was obtained from official and reliable authorities, and the outcomes were defined	Probably low The study adjusted race and gender, and the temporal factors and	Low All records to define the outcomes in the study area during the study period was collected	Probably low No sufficient information to evaluate the completeness of the	Probably low Focused on cardiovascular, respiratory, and injury, and	Low Declared no competing financial	Probably low Poisson regression was performed to test whether there was an association of

	Hurricane Sandy starting and ending months, while did not account for the time-varying cyclone exposures	based on standard ICD code	sociodemographic differences by counties were addressed by utilization of two control groups		outcome data, but the large sample size suggested a potential low risk	emergency department visits, outpatient visits, and hospital admissions were all reported	interests	increased visits/admissions for periods following Superstorm Sandy while controlling for covariates. No study protocol
Ekperi et al. (2018)[34]	Probably low Pre-hurricane (unexposed) and post-hurricane (exposed) period for the study area was defined on the basis of the Hurricane Sandy hit date, while did not account for the time-varying cyclone exposures	Probably Low HIV data was obtained from a reliable health insurance claim database	Probably low Seasonality and autocorrelation were account for	Probably high Only Medicare-eligible retirees are included, which means only privately insured population was represented. The analyses were limited to non-rural areas	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Low Focused on HIV testing rates and reported all relevant findings	Low Declared no competing financial interests	Low Utilized well-established interrupted time-series analysis. No study protocol
Van Loenhout et al. (2018)[35]	Probably high The cyclone exposure for each individual was assessed based on a static point-in-time estimate of cyclone landfall date, which may not consider the varying exposure level and length across individuals accurately, nor did account for the time-varying cyclone exposures	Low Outcome data was obtained from the reliable central hospital registries, and the outcomes were reclassified based on standard ICD code	Probably high No confounders were account for	Low All the people from the two study hospitals were included	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Low Focused on pregnancy, infections, respiratory, genitourinary, digestive, circulatory, and injury and reported all relevant findings	Low Declared no competing financial interests	Probably low Logistic regression was used without covariates but sensitivity analyses were used to prove the robustness of the results. No study protocol
Kim et al. (2017)[36]	Probably low The exposed period for the study area was defined as about 3 months after the Hurricane Sandy hit date and unexposed period was defined as the 2-year period before the Hurricane Sandy hit date, while did account for time-varying cyclone exposures	Low Mortality data was obtained from the reliable authorities, and the outcomes were defined based on standard ICD code	Probably low Seasonality and time trend were account for	Low All the persons whose primary residence was New Jersey and elderly residents aged 76 years or older from 2008 to 2013 were included	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Low Focused on mortality and reported all relevant findings on all-cause and non-infectious respiratory, infectious, cardiovascular disease, unintentional injury, and carbon monoxide poisoning deaths	Probably high No declaration of potential conflict of interest found	Probably low Negative binomial regression models were used to estimate death rates contrasted Hurricane Sandy month or quarter with the comparison period. No study protocol

Bromet et al. (2017)[37]	Probably low Exposure assessment was based on cyclone experience collected by self-reported questionnaire collected from each individual	Low The outcome data was obtained from the reliable authorities, and the possible major depressive disorder was determined based on standard Patient Health Questionnaire	Low Adjusted a series of confounders including age, sex, educational attainment, marital status, responder type, time from pre-Hurricane assessment to the post-Hurricane visit, prior exposure, and prior psychopathology	Low All the persons under the treatment of responders with documented World Trade Centre experience were included	Probably low Only 17 out of 887 participants who did not complete a brief Hurricane Sandy Questionnaire were excluded (1.9%)	Low Focused on posttraumatic stress disorder and overall depression and all the relevant findings were reported	Probably high No declaration of potential conflict of interest found	Probably low Logistic regression was used accounting for a series of confounders. No study protocol
Grabich et al. (2017)[38]	Probably high The exposure of multiple cyclones for the study area was defined a static point-in-time estimate of cyclone hit date, while may not account for the varying strength and length across cyclones accurately, not did account for time-varying cyclone exposures	Low The reproductive health data was obtained from the official reliable authorities, and the possible major depressive disorder was determined based on standard Patient Health Questionnaire	Probably low Seasonality and time trend were account for	Low All Florida pregnancies conceived before or during the 2003 and 2004 hurricane season were included	Low No outcome data was excluded inappropriately	Probably high Focused on reproductive health while only low birth weight, fetal death, and birth rate were studied	Probably high No declaration of potential conflict of interest found	Probably low Difference-in-differences analysis with linear regression was used to assess the risk of adverse reproductive outcomes due to hurricane. No study protocol
Zheng et al. (2017)[39]	Probably low Continuous cyclone exposure was assessed by including the information on the generation and disappearance date, path, landing location, rainfall and wind speed of the cyclones to account for the persistent exposures. However, the exposure level was at the centroid of the cyclone and no wind field model was applied to quantify the exposure level at each location	Low The outcome data was obtained from the official reliable authorities, and all eligible cases were reported by local hospitals that received patients	High No confounders were account for	Low All the eligible records in 42 cities of southeast China were included	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Low After excluding disease unlikely to be affected by TCs and whose numbers of reported cases during both disaster and reference periods were less than 10, this study focused on 14 non-infectious disease and all the relevant findings were reported	Low Declared no competing financial interests	Probably high Crude elevated risks associated with cyclones were derived based on a formula without any adjustment on potential confounders
Schwartz et al. (2017)[40]	Probably low Exposure assessment was based on cyclone experience collected by self-reported questionnaire collected from	Low The outcome data was obtained through surveys from multiple reliable sources and determined via	Low Adjusted a series of confounders including age, gender, race, education, medical	Probably high Convenience-sampling techniques was used while only 19.3% out of the participants at baseline	Probably low The majority of the variables were without missing data, with five variables	Low Focused on mental health symptoms and depression, anxiety, and PTSD	Low Declared no competing financial	Probably low Logistic regression were used to analyse the elevated prevalence risks of

	each individual	previously validated Patient Health Questionnaire-4 (PHQ-4) for depression and anxiety; Civilian PTSD Questionnaire−Hurricane Sandy Specific (PTSD/PCL-S) for PTSD symptoms	insurance, existing mental health conditions, elapsed time between Hurricane and baseline, and mental health condition at baseline	participated in the follow-up study	having one to two missing data, which were treated as missing at random	with all the relevant findings were reported	interests	mental health symptoms associated with cyclone exposure, with a series of secondary analyses being conducted to justify the association. No study protocol
Sharp et al. (2016)[41]	Probably low The exposed period for the study area was defined as about 1 year after the Hurricane Sandy hit date and unexposed period was defined as the 2-year period before the Hurricane Sandy hit date, while did account for time-varying cyclone exposures	Low Medicaid claims data was obtained from official and reliable authorities and were identified by well-established standard coding system (e.g., UB-04 code and ICD code)	Probably low Day of the week and time trend were account for	Low All Medicaid enrolees in the study area were included	Low All Medicaid enrolees, excluding those dually eligible for Medicare, in the study locations during the study period were included	Probably low Focused on health services utilization and all services, diabetes, substance abuse, and mental health related inpatient, outpatient, emergency department, and pharmacy services were reported	Probably high No declaration of potential conflict of interest found	Probably low Negative binomial regression models with generalized estimating equations (GEEs) and Poisson regression were used for each effect period. No study protocol
Dresser et al. (2016)[42]	Probably high Exposure assessment was at country level	Probably low The fatality data was obtained from official reliable authorities while information on specific mechanism of death was not uniformly available	Probably low Adjusted a series of confounders including category of GDP, category storm amplitude, the interaction of GDP category and storm amplitude, and year of storm	Low All data on fatalities in 16 nations between 1958 and 2011 were analysed	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Low Focused on death rate without specifying causes and all the relevant findings were reported	Probably high No declaration of potential conflict of interest found	Probably low Generalized estimating equations with negative binomial regression was used and the selection of model covariates was guided by the quasi-likelihood under independence criterion. No study protocol
Schwartz et al. (2016)[43]	Probably low Exposure assessment was based on cyclone experience collected by self-reported questionnaire collected from each individual	Probably low The outcome data was obtained via self-reported but validated measures of depression, anxiety, and post-traumatic stress symptoms as well as indicators of substance use (alcohol, illicit substance, and tobacco use)	Low Adjusted a series of confounders including age, sex, ethnicity, education, existing mental health status, time elapsed since Hurricane exposure	Probably high Only 407 English-speaking participants living in the Rockaways were included and no clear information on how these participants were selected from the study community, which might be not sufficiently representative to all the residents in Rockaways	Low No outcome data was excluded inappropriately	Low Focused on depression, anxiety, PTSD and substance usage and all the relevant findings were reported	Probably high No declaration of potential conflict of interest found	Probably low Logistic regression was used, with additional analyses conducted to explore the effect of modifiers on the exposure-outcome association by adding an interaction term. No study protocol
Marshall et	Probably low	Low	Probably low	Probably low	Probably low	Low	Probably	Probably low

al. (2016)[44]	Exposed areas were defined based on an impact score as reflected by the cyclone-related power loss; residential, commercial, and municipal damage; emergency shelters established; and gasoline shortages	The outcome data was obtained through official authorities and the study outcomes were diagnosed according to standard ICD code	Seasonality and time trend were account for	All emergency department and hospital discharge data within the study area during the study period were collected	Records were excluded for the same patient where the site and type of injury was the same and the date of hospitalization was within 30 days of a prior hospitalization and the completeness of reporting of work-related injuries was assessed	Focused on work-related unintentional injuries and all the relevant findings were reported	high No declaration of potential conflict of interest found	Descriptive and Poisson regression analyses were used to evaluate the short-term and long-term impact of Hurricane Sandy. No study protocol
Deng et al. (2015)[45]	Probably low Continuous cyclone exposure was assessed by including the information on the generation and disappearance date, path, landing location, rainfall and wind speed of the cyclones to account for the persistent exposures. However, the exposure level was at the centroid of the cyclone and no wind field model was applied to quantify the exposure level at each location	Low The outcome data was obtained through official reliable authorities and was determined by physicians via well-established criteria	Probably low A series of time-invariant confounders such as age, sex, and geographic region were adjusted by a self-matched design	Low All the eligible notified cases of infectious diarrhea in the study areas in Zhejiang Province from 2005 to 2011 were included	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Low Focused on infectious diarrhea and all the relevant findings were reported	Low Declared no competing financial interests	Probably low A standard case-crossover design combined with conditional logistic regression models were used to analyse the exposure odds for the case period compared with the control period. No study protocol
Wang et al. (2015)[46]	Probably low Cyclone exposure was assessed based on the officially reported cyclone date and length, while did not account for the cyclone strength and time-varying cyclone exposures	Low Daily disease surveillance data on infectious diarrhea was obtained through official reliable authorities and was determined via well-established criteria	Probably high Time trend and natural variation were all not accounted for	Low Almost all the incidences in Guangdong, China, were recorded and included	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Low Focused on infectious diarrhea and all the relevant findings were reported	Probably high No declaration of potential conflict of interest found	Probably high Crude elevated risks associated with cyclones were derived based on a formula without any adjustment on potential confounders
Tian and Guan (2015)[47]	Probably high Exposed period was defined as the cyclone year (2005) and unexposed period was defined as the year (2004) before cyclone year (2005), which may not consider the cyclone start date accurately	Low Outcome records were obtained from official reliable authorities	Probably low Adjusted a series of confounders including Gender, race, economic status, grade and school sites	Low All Louisiana K12 students in US during 2000–2008 were studied	Probably low A loss of 6.78% observations happened after 2005 when Katrina happened	Low Focused on displaced students' behavioural disorder and all the relevant findings were reported	Low Declared no competing financial interests	Probably low Difference-in-differences analysis with linear probability mod was used to investigate the effect of Hurricane Katrina on students' in-school behaviour. No study

								protocol
Antipova and Curtis (2015)[48]	Probably low Exposed area was defined as the areas within the 20-mile buffer of the officially recorded cyclone track, an area with sustain little or no damage was selected as the comparison (unexposed) area	Low Birth and death certificate records were obtained from official reliable authorities and the study outcomes were defined using standard criteria	High No confounders were account for	Low All outcome data was obtained from the study area for the study period of 1991 to 1995 was obtained	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Low Focused on birth outcomes. Two main pregnancy outcomes (i.e., preterm birth and low birth weight) and all the relevant findings were reported	Probably high No declaration of potential conflict of interest found	Probably high A Chi-squared test coupled with the Cochran-Mantel Haenszel statistic (CMH) was applied to see if the proportion of preterm and low-weight births were significantly different before and after the hurricane without considering any confounders. No study protocol
Swerdel et al. (2014)[49]	Probably low Exposed period was defined as the 2 weeks after the cyclone hit date and unexposed period was defined as the 2 weeks before the cyclone hit date	Low The outcome data was obtained from the official reliable authorities and was defined using standard ICD codes	Probably low Natural variations was accounted for	Probably low Outcome data was obtained from all the non-federal hospitals in the study area	Probably low The diagnosis in the data system for myocardial infarctions and stroke were supported in 91% and 89% of cases	Low Focused on cardiovascular events and all the relevant findings for myocardial infarctions and strokes were reported	Low Declared no competing financial interests	Probably low Poisson regression was used with parameter estimates determined via generalized estimating equations with robust variances for repeated measures. No study protocol
Kim et al. (2013)[50]	Probably high Exposed periods was defined as the cyclone period, which did not consider the different cyclone strength and length across cyclones and study areas, nor did account for the time-varying exposure	Low The mortality data was obtained from the official reliable authorities and diagnosed via standard ICD code	High No confounders were adjusted	Low All mortality data from study areas was obtained	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Low Focused on infectious diarrhea and all the relevant findings were reported	Probably high No declaration of potential conflict of interest found	Probably high Crude elevated risks associated with cyclones were derived based on a formula without any adjustment on potential confounders
Frahm et al. (2013)[51]	Probably high Cyclone exposure was defined based on the cyclone track and hit date, which did not consider the different cyclone strength and length across cyclones and study areas	Low The outcome data was obtained from the official reliable authorities and diagnosed via standard ICD code	Probably high No clear confounders were adjusted	Low All Florida veterans between October 2003 and September 2006 were studied	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Low Focused on outpatient visits for posttraumatic stress disorder and substance use treatment and all the relevant findings were reported	Probably high No declaration of potential conflict of interest found	Probably high Student's t test or Chi-square and a repeated measures linear mixed modelling approach without any clear adjustment was used. No study protocol

Fullerton et al. (2013)[52]	Probably low Exposure assessment was based on cyclone experience collected by self-reported questionnaire collected from each individual	Low The outcome data was obtained from the official reliable authorities and diagnosed via well-established standard questionnaires	Probably low Adjusted a series of confounders including gender, race, education, marital status, work demand	Probably low Most of the study population participated in the study (77.5%).	Probably high A large percentage of the outcome data was excluded due to the missing data (34.9%)	Low Focused on posttraumatic stress disorder, probable depression, and increased alcohol and/or tobacco use and all the relevant findings were reported	Probably high No declaration of potential conflict of interest found	Probably low Logistic regression was used to estimate the risk associated with cyclones, complemented by a series of secondary analyses. No study protocol
Lin et al. (2013)[53]	Probably high Exposed period for different cyclones was defined as the 6 days after the cyclone hit date and unexposed period was defined as the 2 days before the cyclone hit date, which did not consider the different cyclone strength and length across cyclones and time-varying exposures	Low The outcome data was obtained from the official reliable authorities and diagnosed by standard ICD code	Probably low Adjusted a series of confounders including daily rainfall, the size of an ED, hospital contract type, weekdays, holidays	Low The data of the study was retrieved from a database that covers over 99% of Taiwan's population.	Probably low 10 out of 30 study hospitals with EDs were excluded due to a irregular ED service or small volumes of ED visits	Low Focused on non-specific emergency department visits and all the relevant findings for both non-traumatic and common traumatic outcomes (e.g., fractures or dislocations of extremities, lacerations, superficial injuries and traumatic brain injuries) were reported	Probably high No declaration of potential conflict of interest found	Probably low Linear regression accounting for interactive effects among direct landfall, daily rainfall (heavy rain vs. light or no rain), intensity of typhoon, days since typhoon landfall, and the yearly average of daily ED visits on the outcome variable was used. Inadequate information provided to judge the compliance with study protocol
Howard et al. (2012)[54]	Probably low Exposed period was defined as the 9-day period after the cyclone hit date and all the other days were defined as unexposed period	Low The outcome data was obtained from the reliable clinics and identified using standard of 2008 Standard Analytical Files (SAF)	Probably low Adjusted a series of confounders including age, sex, race, Medicaid coverage, clinical characteristics	Probably high The outcome data of hospitalization was obtained from Medicare billing records and hospital admissions can thus be observed only for those patients for whom Medicare is a primary or secondary payer	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Low Focused on dialysis and all the relevant findings were reported	Probably high No declaration of potential conflict of interest found	Probably low Cox proportional hazard models with a time-varying Hurricane Katrina indicator was used to identify the impact of Hurricane Katrina on hospitalization rates. No study protocol
Mills et al. (2012)[55]	Probably low Exposure assessment was based on self-reported questionnaire collected from each individual	Probably low The outcome data was obtained through a structured questionnaire by trained research assistants (possible recall bias)	Probably low Adjusted a series of confounders including gender, material losses, health care need, death of loved	Probably low The included participant showed good representativeness of the study population of emergency department	Probably low Of the 908 eligible participants, 747 (82%) people completed the interview and were	Low Focused on post-traumatic stress disorder and all the relevant findings were reported	Probably high No declaration of potential conflict of	Probably low Logistic regression was used. Model fit was assessed with the Hosmer-Leme goodness-of-fit test.

			one	population during the cyclone period within the study area	included		interest found	The discriminatory power of the model was investigated by generating a receiver operating characteristic curve for the model and evaluating the area under the curve. No study protocol
Panda et al. (2011)[56]	Probably low Pre-cyclone (unexposed) and post-cyclone (exposed) period was defined on the basis of the cyclone hit date, while did not account for the time-varying cyclone exposures	Low The outcome data (in-patients with diarrhoea and rectal swabs) was obtained through reliable authorities and antibiotic sensitivity testing was performed based on a well-established method	Probably high No clear confounders were adjusted	Low All the patients undergoing diarrhoea in the study district were studied	Low The coverage for in-patients achieved was estimated to be 93%, showing a relatively high completeness	Low Focused on diarrhoea and all the relevant findings (e.g., causative organisms for diarrhoea and antibiotic susceptibility profile) were reported	Probably high No declaration of potential conflict of interest found	Probably high Crude elevated risks associated with cyclones were derived based on a formula without any adjustment on potential confounders
Dosa et al. (2010)[57]	Probably low The exposed period and area was defined as the warning zone at 24 hours before landfall by National Weather Service, while did not account for the time-varying cyclone exposures	Low The outcome data was obtained from officially reliable authorities	Probably high No clear confounders were adjusted	Low All the residents living in two study locations were considered	Low 123 out of 9383 (1.3%) participants who did not contribute data for all 3 years and for residents who could not be matched to their Medicare Denominator File were excluded	Low Focused on the overall mortality, hospitalization, and functional decline and all the relevant findings were reported	Low Declared no competing financial interests	Probably high Crude elevated risks associated with cyclones were derived based on a formula without any adjustment on potential confounders
Zahran et al. (2010)[58]	Probably high The exposure for each individual was assessed based on a static point-in-time estimate of cyclone hit date, which may not account for different length and strength of cyclone across individuals accurately	Probably low The outcome data was obtained from officially reliable authorities	Low Adjusted a series of confounders including maternal Rh sensitization, diabetes, oligohydramnios, abruptio placenta, infant birth weight, infant cord prolapsed, maternal cigarette and alcohol use, maternal age	Probably low A very large and representative sample of the pregnant women in the study area was included	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Low Focused on fetal distress risk due to maternal exposure to Hurricane Andrew and all the relevant findings were reported	Probably high No declaration of potential conflict of interest found	Probably low Logistic regression was used to model fetal distress risk as a function of maternal exposure to Hurricane Andrew. No study protocol

Kutner et al. (2009)[59]	Probably high The exposure for each individual was assessed based on a static point-in-time estimate of cyclone hit date, which may not account for different length and strength of cyclone across individuals accurately	Probably low The outcome data was obtained from officially reliable authorities	Low Adjusted a series of confounders including age, gender, race, income status, and clinical characteristics	Probably low The included patients represented 10% of the Katrina-affected study population and had similar demographic and clinical characteristics to the rest of the study population.	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Low Focused on risk of mortality of dialysis patients due to exposure to Hurricane Katrina and all the relevant findings were reported	Low Declared no competing financial interests	Probably low Cox proportional hazard models were used with a function of a time-varying Katrina indicator and adjustment for well-established demographic and clinical risk factors. Subgroup and sensitivity analyses were conducted. No study protocol
Burton et al. (2009)[60]	Probably high The exposure for each individual was assessed based on a static point-in-time estimate of cyclone hit date, which may not account for different length and strength of cyclone across individuals accurately	Low The mortality, morbidity, and disease and service utilization data were all obtained from officially reliable authorities and were determined by well-established criteria (i.e., ACGs) derived from standard ICD code	High No confounders were account for	Probably Low Al non-institutionalized People Health (PH) enrolees (aged > 65 years) who lived in 4 parishes in the New Orleans metropolitan area served by PH providers before Hurricane Katrina were included.	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size suggested a potential low risk	Low Focused on mortality, morbidity, and disease and service utilization and all the relevant findings were reported	Low Declared no competing financial interests	Probably high Crude elevated rates after cyclones were derived based on a formula without any adjustment on potential confounders
Tees et al. (2009)[61]	Probably low Exposure assessment was based on self-reported questionnaire collected from each individual	Low The birth records was obtained from reliable hospitals and the interviews were conducted by a research assistant. The mental health condition of mothers and infant temperament were measured via well-established standard questionnaires	Probably low Adjusted a series of confounders including mother's age, infant's age, income level, marital status, smoking status prior to pregnancy, parity	Probably Low All the women giving birth between February 2006 and May 2007 at two hospitals that served a wide selection of their respective metro areas of the study region were recruited	Probably high 292 out of 365 (80%) women completed the interview at 8–10 weeks postpartum. In other words, 20% of the participants were dropped out due to missing data	Low Focused on maternal stress, maternal mental health, and early infant temperament and all the relevant findings were reported	Low Declared no competing financial interests	Probably low Logistic regression was used with adjusting a series of potential confounders. No study protocol
Fonseca et al. (2009)[62]	Probably high The exposure for each individual was assessed based on a static point-in-time estimate of cyclone hit date, which may not account for different length and strength of cyclone across individuals accurately, nor did consider the time-varying	Probably low The outcome data was obtained from officially reliable authorities	High No confounders were account for	Low All the adult patients with diabetes and an A1C measurement 6 months before Hurricane Katrina and 6-16 months after Hurricane Katrina were identified from databases were considered	Low All the eligible patients seen at TUHC and MCLNO systems and 748 (out of 750, 99.7%) randomly selected patients were studied	Probably low Focused on diabetics and included and reported findings on a series of important indicators (level of A1C, blood pressure, and	Low Declared no competing financial interests	Probably high Crude elevated rates after cyclones were derived based on a formula without any adjustment on potential confounders

	exposure					lipids)		
Anastario et al. (2009)[63]	Probably high The exposure for each individual was assessed based on a static point-in-time estimate of cyclone hit date, which may not account for different length and strength of cyclone across individuals accurately, nor did consider the time-varying exposure	Probably low The outcome data was obtained from officially reliable authorities and via pilot tested structured questionnaires (possible recall bias)	High No confounders were account for	Probably low The participants were selected from the study population based on a systematic, random sampling procedure	Probably high 73 out of 123 (59.35%) sample sites were excluded in 2016 and 65 out of 134 (48.51%) sample sites were excluded due to data unavailability	Low Focused on gender-based violence among women internally displaced in Mississippi 2 years post–hurricane Katrina and all the relevant findings were all reported	Low Declared no competing financial interests	Probably high Crude elevated rates after cyclones were derived based on a formula without any adjustment on potential confounders
Harville et al. (2009)[64]	Probably low Exposure assessment was based on self-reported questionnaire of cyclone experience collected from each individual	Probably low The outcome data was obtained from reliable hospitals and via standard recruitment questionnaires and phone interview at hospitals (possible recall bias)	Probably low Adjusted a series of confounders including age, race, income, education, marital/partnership status, and parity	Probably high The women were included from only two hospitals in the study area	Probably high 292 out of 365 (80%) recruited women participated in the phone interview while 40% failed to complete during the follow-up	Low Focused on postpartum mental health and all the relevant findings for depressive symptoms and PTSD symptoms were all reported	Low Declared no competing financial interests	Probably low Loglinear/Poisson regression were used to model relative risks with control for potential confounders. Protocols were approved by the Institutional Review Boards of Tulane University and Woman's Hospital
Xiong (2008)[65]	Probably low Exposure assessment was based on self-reported questionnaire of cyclone experience collected from each individual	Probably low The outcome data was obtained from medical records in reliable hospitals and via interviews (possible recall bias)	Probably low Adjusted a series of confounders including maternal age, race, parity, education, marital status, smoking, alcohol consumption, family income, and history of low birth weight	Probably high The women were included from only two hospitals in the study area	Low No outcome data was excluded inappropriately	Low Focused on PTSD and birth outcomes and all the relevant findings for PTSD symptoms, preterm birth, and low birth weight were reported	Probably high No declaration of potential conflict of interest found	Probably low Chi-square tests were used to examine differences in proportions and logistic regression was used to adjust for the effects of confounding variables. No study protocol
Kessler et al. (2006)[66]	Probably high The exposure for each individual was assessed based on a static point-in-time estimate of cyclone hit date, which may not account for different length and strength of cyclone across individuals accurately	Probably low The outcome data was obtained from official reliable authorities via surveys based on well-established screening scale	High No confounders were account for	Probably high The eligible adults were included from only two Census Divisions in the study area	Probably high Around 29% of the outcome data was excluded due to missing data	Low Focused on mental illness and suicidality and all the relevant findings were reported	Low Declared no competing financial interests	Probably low Logistic regression was used to assess the sociodemographic variation in between-survey differences. No study protocol
Fried et al.	Probably low	Probably low	Probably low	Low	Low	Low	Probably	Probably low

(2005)[67]	Exposed period of the study area was defined as the 12 months after the Hurricane Floyd hit date and unexposed period was defined as the 14 months before the Hurricane Floyd hit date	The outcome data was obtained from official reliable authorities	Time trend and time invariant county characteristics was controlled using a difference in difference modelling approach	All the Medicaid population in North Carolina were considered	No exclusions were made for continuous enrolment or other enrolee characteristics	Focused on utilization of mental health services after hurricane Floyd and all the relevant findings were reported	high No declaration of potential conflict of interest found	Difference-in-differences analysis with linear regression was used with robust standard errors reported. No study protocol
Keenan et al. (2004)[68]	Probably low Exposed period of the study area was defined as the 6 months after the Hurricane Floyd hit date and unexposed period was defined as the period before the Hurricane Floyd hit date	Low The outcome data was retrospectively obtained from official reliable authorities and prospectively collected as a part of an ongoing project and were defined based on standard ICD code	Probably low Adjusted a series of confounders including county risk level, exposure period, race, age	Probably low The eligible children were included from all hospitals in the study area during the study period	Low No outcome data was excluded inappropriately	Low Focused on inflicted traumatic brain injury in children and all the relevant findings were reported	Probably high No declaration of potential conflict of interest found	Probably low Poisson regression was used to compare the risks in the exposed period with the unexposed period
Sanders et al. (1999)[69]	Probably high The exposure for each individual was assessed based on a static point-in-time estimate of cyclone hit date, which may not account for different length and strength of cyclone across individuals accurately	Low The outcome data was obtained via laboratory testing and defined based on well-established standard criteria	High No confounders were account for	Probably low Medical records of the study area were obtained from a series of medical authorities including public health clinics, public and private hospitals, laboratories, and private physicians' offices throughout Puerto Rico	Low No outcome data was excluded inappropriately	Low Focused on leptospirosis in dengue-negative patients and all the relevant findings were reported	Probably high No declaration of potential conflict of interest found	Probably high Crude elevated risks associated with cyclones were derived based on a formula without any adjustment on potential confounders
Hendrickson et al. (1997)[70]	Probably low Exposed period of the study area was defined as the 2 weeks after the Hurricane Iniki hit date and unexposed period was defined as the 2-week period before the Hurricane Iniki hit date	Low Outcome data was obtained from medical authorities and the study outcomes were defined based on standard ICD code	Probably high The time trend, seasonality and day of week effects were all not accounted for	Probably low Medical records of the study area were obtained from a series of medical authorities including multispecialty medical groups, family practice clinics, and paediatricians, and emergency departments	Probably low Medical records with an incomplete address and unknown resident status (10.8%)	Probably low Included a series of morbidity-related outcomes including injury, cardiovascular and asthma-related physician visits and reported all relevant findings	Probably high No declaration of potential conflict of interest found	Probably high Crude elevated risks associated with cyclones were derived based on a formula without any adjustment on potential confounders
Hendrickson and Vogt (1996)[71]	Probably low Exposed period of the study area was defined as the 1 year after the Hurricane Iniki hit date and unexposed period was defined as the 5-year period before the Hurricane	Low Outcome data was obtained from official sources and the study outcomes were defined based on standard ICD code	High No confounders were account for	Low All mortality records were obtained from the study area of Kauai during the study period	Probably low No sufficient information to evaluate the completeness of the outcome data, but the large sample size	Probably low A series of cause-specific mortality outcomes including mortality from diabetes, heart disease,	Probably high No declaration of potential conflict of interest	Probably high Crude elevated risks associated with cyclones were derived based on a formula without any adjustment on

	Iniki hit date, while did not account for the time-varying cyclone exposure				suggested a potential low risk	stroke, cancer, injury, respiratory diseases were included and reported in the study, though the associations were statistically insignificant	found	potential confounders
Garrison et al. (1993)[72]	Probably low Exposure assessment was based on self-reported questionnaire of cyclone experience collected from each individual	Probably low The outcome data was collected via well-established self-administered questionnaire by trained research assistants but the recall bias may occur	Probably low Sex, race, and other traumatic events exposure were controlled in the model	Probably high The eligible students were included from only three schools and no clear information on how these three schools were selected	Low No outcome data was excluded inappropriately	Low Focused on PTSD in adolescents and all the relevant findings were reported	Probably high No declaration of potential conflict of interest found	Probably low A series of logistic regression analyses were used to explore the relation between exposure to the hurricane and PTSD. A backward stepwise elimination procedure was performed to determine the final model. No study protocol

Abbreviations: A1C, glycemic control; ACGs, adjusted clinical groups; BMI, body mass index; CCS, Clinical Classifications Software; COPD, chronic obstructive pulmonary disease; ED, emergency department; FEMA, Federal Emergency Management Agency; ICD, International Classification of Diseases; MCLNO, Medical Center of Louisiana at New Orleans; PTSD, post-traumatic stress disorder; TUHC, Tulane University Hospital and Clinic.

TableS6: Summary of the studies included in meta-analysis and sensitivity analysis by excluding each effect estimate in turn.

Study	Included cyclone(s)	Study population	RR (95% CI)[a]	Weight	meta-RR (95% CI)[b]
All-cause mortality					
Quast et al. (2019)[30]	Hurricane Katrina and Rita	Participants with diabetes	1.10 (1.08,1.12)	18.5	1.09 (1.02,1.15)
Kutner et al. (2009)[59]	Hurricane Katrina	Participants with dialysis	0.98 (0.86,1.11)	13.2	1.10 (1.05,1.14)
Dosa et al. (2020)[25]	Hurricane Irma	General population (≥ 65 years)	1.12 (1.05,1.18)	17.2	1.08 (1.03,1.14)
Kim et al. (2017)[36]	Hurricane Sandy	General population (≥ 76 years)	1.07 (1.05,1.10)	18.4	1.09 (1.03,1.16)
Cruz-Cano and Mead (2019)[31]	Hurricane Maria	General population (All ages)	1.25 (1.13,1.40)	14.5	1.08 (0.91,1.27)
Kim et al. (2013)[50]	Three TCs	General population (All ages)	1.04 (1.01,1.07)	18.2	1.10 (1.05,1.15)
Overall	-	-	1.09 (1.04,1.13)	100	-
Heart disease mortality					
Cruz-Cano and Mead (2019)[31]	Hurricane Maria	General population (All ages)	1.29 (1.12,1.53)	29.6	1.08 (0.91,1.27)
Quast et al. (2019)[30]	Hurricane Katrina and Rita	Participants with diabetes	1.15 (1.11,1.19)	46.2	1.09 (1.02,1.15)
Hendrickson and Vogt (1996)[71]	Hurricane Iniki	General population (All ages)	0.96 (0.79,1.17)	24.2	1.19 (1.07,1.32)
Overall	-	-	1.14 (0.99,1.30)	100	-
Diabetes mortality					
Cruz-Cano and Mead (2019)[31]	Hurricane Maria	General population (All ages)	1.41 (1.15,1.84)	30.1	1.08 (0.91,1.27)
Quast et al. (2019)[30]	Hurricane Katrina and Rita	Participants with diabetes	0.91 (0.85,0.98)	62.7	1.09 (1.02,1.15)
Hendrickson and Vogt (1996)[71]	Hurricane Iniki	General population (All ages)	2.61 (1.44,4.74)	7.3	1.19 (1.07,1.32)
Overall	-	-	1.41 (0.80,2.47)	100	-
All-cause hospitalization					
Bell et al. (2021)[13]	Hurricane Frances	General population (≥ 65 years)	1.15 (1.13,1.17)	10.3	1.18 (1.12,1.26)
Bell et al. (2021)[13]	Hurricane Ivan	General population (≥ 65 years)	1.20 (1.18,1.22)	10.3	1.18 (1.11,1.25)
Bell et al. (2021)[13]	Hurricane Katrina	General population (≥ 65 years)	1.20 (1.16,1.24)	10.1	1.18 (1.11,1.25)
Bell et al. (2021)[13]	Hurricane Wilma	General population (≥ 65 years)	1.25 (1.22,1.28)	10.2	1.17 (1.11,1.24)
Bell et al. (2021)[13]	Hurricane Rita	General population (≥ 65 years)	1.16 (1.14,1.17)	10.3	1.18 (1.11,1.26)
Bell et al. (2021)[13]	Hurricane Ike	General population (≥ 65 years)	1.22 (1.19,1.26)	10.1	1.18 (1.11,1.25)
Bell et al. (2021)[13]	Hurricane Irene	General population (≥ 65 years)	1.15 (1.13,1.17)	10.3	1.18 (1.12,1.26)
Bell et al. (2021)[13]	Hurricane Sandy	General population (≥ 65 years)	1.37 (1.34,1.39)	10.3	1.16 (1.11,1.22)
Sharp et al. (2016)[41]	Hurricane Sandy	General population (All ages)	0.98 (0.95,1.01)	10.2	1.21 (1.16,1.25)

Howard et al. (2012)[54]	Hurricane Katrina	Participants with dialysis	1.16 (1.05,1.29)	7.9	1.18 (1.12,1.25)
Overall	—	—	1.18 (1.12,1.25)	100	—
RESP hospitalization					
Van Loenhout et al. (2018)[35]	Typhoon Haiyan	General population (All ages)	1.75 (1.01,3.03)	4.9	1.15 (1.13,1.18)
Parks et al. (2021)[21]	All TCs hit US between 1999–2014	General population (≥ 65 years)	1.14 (1.10,1.18)	47.3	1.18 (0.96,1.45)
Yan et al. (2021)[22]	74 Atlantic-basin TCs	General population (≥ 65 years)	1.16 (1.13,1.20)	47.8	1.31 (0.87,1.99)
Overall	—	—	1.15 (1.13,1.18)	100	—
COPD hospitalization					
Bell et al. (2022)[4]	Eight large-scale hurricanes	General population (≥ 65 years)	1.06 (1.04,1.08)	35.4	1.37 (1.25,1.51)
Parks et al. (2021)[21]	All TCs hit US between 1999–2014	General population (≥ 65 years)	1.44 (1.37,1.54)	32.4	1.18 (0.96,1.45)
Yan et al. (2021)[22]	74 Atlantic-basin TCs	General population (≥ 65 years)	1.31 (1.23,1.39)	32.2	1.31 (0.87,1.99)
Overall	—	—	1.26 (1.05,1.50)	100	—
Preterm birth					
Meir et al. (2021)[20]	Hurricane Katrina	Pregnant women	1.02 (0.88,1.18)	22.3	1.11 (0.87,1.41)
Antipova and Curtis (2015)[48]	Hurricane Andrew	Pregnant women	1.43 (1.26,1.62)	23.7	1.01 (0.99,1.03)
Sun et al. (2020)[27]	58 TCs	Pregnant women	1.01 (0.99,1.03)	28.2	1.12 (0.87,1.43)
Harville et al. (2022)[8]	Hurricane Michael	Pregnant women	0.96 (0.88,1.05)	25.7	1.13 (0.91,1.42)
Overall	—	—	1.09 (0.91,1.29)	100	—

[a]Relative risks of the health outcome after the cyclone exposures

[b]Meta-relative risks for the health outcome after excluding the estimate

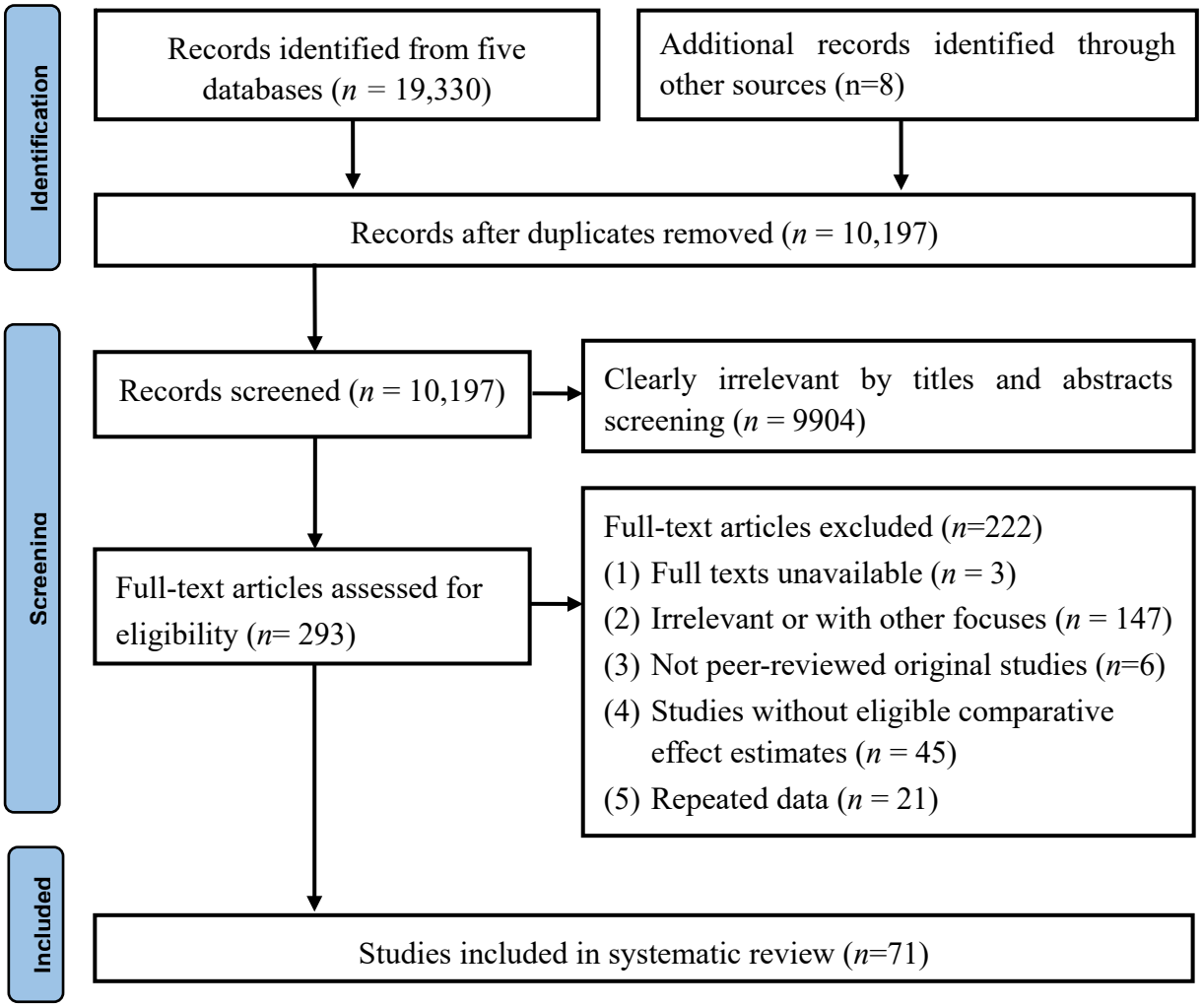

Figure S1. Flowchart of the study selection

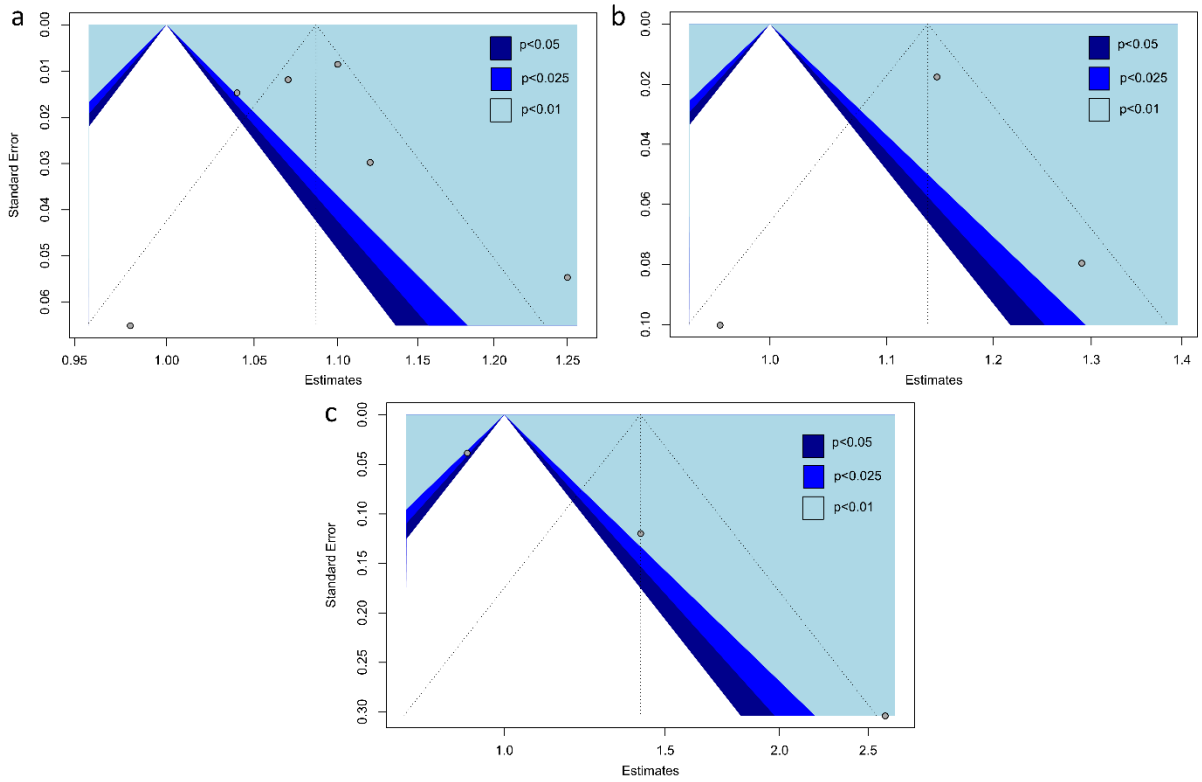

Fig.S2 Contour-enhanced funnel plot analysis on the detection of publication bias in the meta-analysis of the association between cyclone exposures and all-cause (a), heart disease (b) and diabetes (c) mortality, with background color indicating the significance of the studies ($P \geq 0.05$: white background; $P < 0.05$: dark blue; $P < 0.025$: blue; $P < 0.01$: light blue)

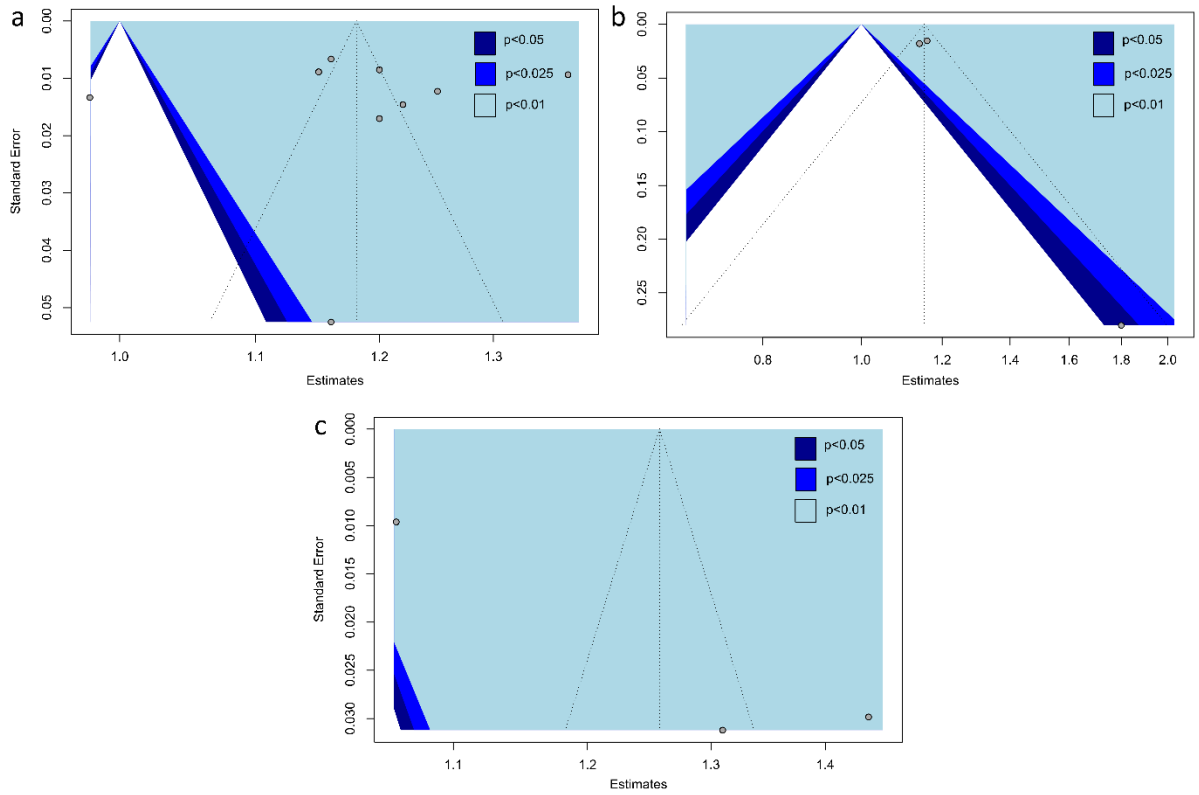

Fig.S3 Contour-enhanced funnel plot analysis on the detection of publication bias in the meta-analysis of the association between cyclone exposures and all-cause hospitalization (a), respiratory hospitalization (b) and chronic obstructive pulmonary disease hospitalization, with background color indicating the significance of the studies ($P \geq 0.05$: white background; $P < 0.05$: dark blue; $P < 0.025$: blue; $P < 0.01$: light blue)

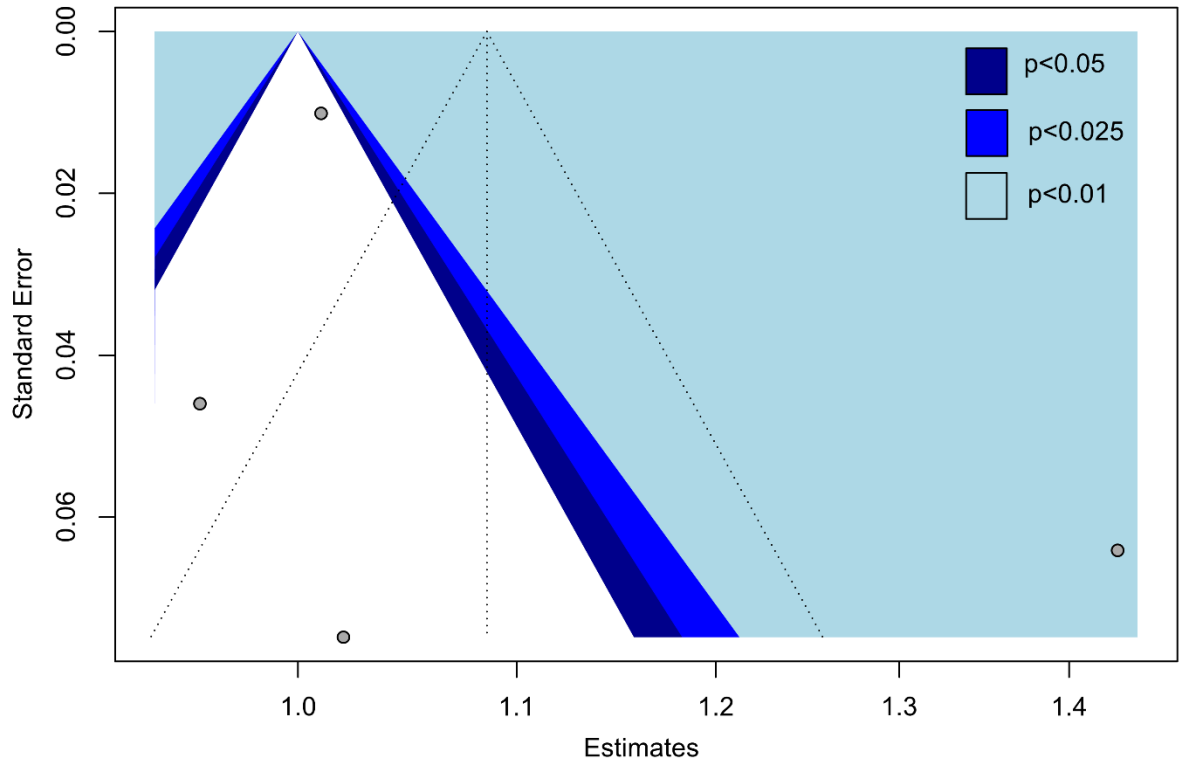

Fig.S4 Contour-enhanced funnel plot analysis on the detection of publication bias in the meta-analysis of the association between cyclone exposures and preterm birth, with background color indicating the significance of the studies ($P \geq 0.05$: white background; $P < 0.05$: dark blue; $P < 0.025$: blue; $P < 0.01$: light blue)

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