Supporting Information

Untangling the impacts of climate change on waterborne diseases: A systematic review of relationships between diarrheal diseases and temperature, rainfall, flooding, and drought

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Supplemental Material, Table S1: Articles included in the systematic review of the relationship between ambient temperature and diarrheal diseases. Direction of association columns indicate the number of analyses presented by the authors of the article that resulted in a positive ("+"), negative ("-"), or neutral ("0") association between exposure of interest and outcome, based on statistical analysis. Positive or negative relationships were defined as $p<0.05$ or 95% CI did not include the null. "NA" indicates article did not present results of a statistical analysis.

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size	Direction of Association			
											+	-	0	NA
Alexander et al. 2013	Botswana	1974 - 2003	All ages	All-cause	Minimum temperature (monthly)	Monthly proportion deviation from yearly mean diarrheal incidence reported to government health facilities	Temperature positively associated with diarrhea in the dry season and negatively associated with diarrhea in the wet season.	No association between diarrhea and maximum or mean monthly temperature (results not shown).	Surveillance Records	NA	1	1		
Ali et al. 2013	Matlab, Bangladesh	1988 - 2001	All ages	Bacterial	Minimum temperature (monthly)	Monthly incidence of cholera diagnosed at ICDDR,B	For each 1°C increase in monthly minimum temperature, cholera incidence increased by 6%.	Adjusted for season, autocorrelation, and sea surface temperature. Also examined maximum temperature but correlation stronger using minimum temperature.	Hospital Surveillance	4,157 cholera cases in the study period	1			
Atchison et al. 2010	England, Wales, Scotland, and the Netherlands	1993 - 2007	< 5	Viral	Population-weighted, mean temperature (weekly)	Weekly counts of laboratory-confirmed rotavirus cases	13% decrease in rotavirus cases for each 1°C increase in weekly temperature above a threshold of 5°C.	Temperature measure is population weighted, based on mean of multiple weather stations.	Surveillance Records	NA		1		
Bandyopadhyay et al. 2012	14 countries in sub-Saharan Africa	1991 - 2000	< 3	All-cause	Maximum and minimum temperatures (3-month weighted average)	2-week, self-reported diarrhea prevalence from the DHS survey	Diarrhea prevalence positively associated with average monthly maximum temperature and negatively associated with average monthly minimum temperature in the dry season.	Excluded from the quantitative analysis because used 3-month average temperature.	Surveillance Records	NA	0	0		1
Bennett et al. 2012	Lima, Peru	1995 - 1998	< 13	All-cause	El Niño period versus period prior to El Niño onset	Household-reported diarrhea assessed by daily survey	Higher incidence of diarrhea was observed in El Niño vs. control period. Peak in diarrhea incidence shifted from summer/fall to spring during El Niño periods.	Protozoan infection (*G. lamblia,* Cryptosporidium and *Cyclospora*) by weekly stool sample also assessed.	Cohort study	367 children				1
Bern et al. 2000	Guatemala City, Guatemala	1997 - 1998	All ages	Protozoan	Average temperature (monthly)	Prevalence of laboratory-confirmed *Cyclospora* and *Cryptosporidium* among outpatients	*Cyclospora* prevalence was higher in warmer months but was not clearly associated with temperature.	*Cyclospora* prevalence peaked at the onset of rainy season. Also screened people without diarrhea.	Hospital Study	5,520 specimens screened				1
Bhandari et al. 2012	Jhapa District, Nepal	1999 - 2008	All ages	All-cause	Maximum and minimum temperature (monthly)	Cases of diarrhea reported to the Department of Health Services	No significant association between diarrhea and maximum or minimum temperature.		Surveillance Records	NA			2	

Supplemental Material, Table S1 (continued) – Ambient Temperature

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size	Direction of Association			
											+	-	0	NA
Bi et al. 2008	Adelaide and Brisbane, Australia	1990 - 2005	All ages	Bacterial	Maximum temperature (weekly)	Weekly cases of laboratory-confirmed *Campylobacter* infections reported to Departments of Health	Temperature and *Campylobacter* are negatively associated in Adelaide (using a 9 week lag), and positively associated in Brisbane (6 and 3 week lag).	Authors do not present minimum temperature models but say the results are similar to maximum temperature model results.	Surveillance Records	34,908 cases	1	1		
Britton et al. 2010	New Zealand	1965 - 2006	All ages	Bacterial	Average temperature (monthly)	Monthly number of salmonellosis cases reported to the national disease surveillance system	15% increase in reported *Salmonella* cases for each 1° C increase in monthly temperature in the same month.	When analysis was stratified by decade, the strongest association was observed in 1965-1974 and decreased in subsequent decades.	Surveillance Records	NA	1			
Chai et al. 2001	Chollanam-do Province, Korea	1996 - 1997	All ages	Protozoan	Average temperature (monthly)	Monthly prevalence of *Cryptosporidium* positive stool samples	Average monthly temperature not associated with *Cryptosporidium* oocyst prevalence (r=0.04).	77% of the residents were over the age of 50.	Cohort Study	135 villagers				1
Chakravarti et al. 1992a	New Dehli, India	1987 - 1989	< 5	Viral	Minimum and maximum temperature (monthly)	Monthly percent of acute gastroenteritis patients that tested positive for rotavirus at a hospital	Monthly minimum temperature was negatively correlated with monthly rotavirus prevalence. Maximum temperature was not associated with rotavirus.	Correlation coefficients not provided. An earlier analysis of 288 children from the same population found no association (Chakravarti et al 1992b).	Hospital Study	978 children		1	1	
Checkley et al. 2000	Lima, Peru	1993 - 1998	< 10	All-cause	Average temperature (daily)	Number of daily admissions for diarrhea at one hospital	El Niño associated with significantly more diarrhea admissions (200% higher than prior rate). RR of daily admission for diarrhea 1.08 for each 1°C increase in temperature in pre El Niño period.	Greater effect of increased ambient temperature during cooler (May-Nov, RR 1.12) vs. warmer months (Dec - April 1.04).	Hospital Records	57,331 children admitted with diarrhea	1			
Chou et al. 2010	Taiwan	1996 - 2007	All ages	All-cause	Maximum temperature (monthly)	Monthly incidence of hospital admissions for diarrhea from National Health Insurance Research database	Maximum temperature positively associated with diarrhea hospitalizations (IRR 1.01, 95% CI 1.00, 1.03). Greatest effect in children, 0-14 years.	1-month lagged, maximum temperature was selected for the final model, though several lags and temperature variables were tested univariately.	Medical Records	1,212,621 cases of diarrhea	1			
Dean and Jones 1972	The Phillipines	1969 - 1970	All ages	All-cause	Maximum temperature (monthly)	Monthly diarrhea cases at military ER	Increase in number of ER visits for diarrhea that lags behind increases in average daily temperature.	Peak in cases precedes heaviest rainfall periods.	Hospital Study	5,000-6,000 acute gastroenteritis cases annually				1

Supplemental Material, Table S1 (continued) – Ambient Temperature

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size	Direction of Association			
											+	-	0	NA
Dewan et al. 2013	Dhaka, Bangladesh	2005 - 2009	All ages	Bacterial	Average temperature (weekly)	Weekly number of typhoid cases admitted to 11 hospitals	14.2% increase in the number of cases of typhoid per week for each 1°C increase in temperature (95% CI 4.4%, 25%).	Adjusted for season, river levels, rainfall, holidays, and inter-annual variations.	Hospital Records	4,355 typhoid cases	1			
D'Souza et al. 2004	5 cities in Australia	1991 - 2001	All ages	Bacterial	Average temperature (monthly)	Monthly incidence of reported *Salmonella* infections	Significant positive association between the monthly incidence of *Salmonella* infections and 1-month lagged, mean monthly temperature; IRR ranged from 1.04 to 1.10 in the 5 cities studied.		Surveillance Records	27,652 reported cases	5			
D'Souza et al. 2008	Brisbane, Canberra, and Melbourne, Australia	1993 - 2003	< 5	Viral	Average temperature (weekly)	Incidence of rotavirus infection based on admissions	Significant negative association between the weekly incidence of rotavirus infections and one-week lagged mean weekly temperature; IRR ranged from 0.95 to 0.98 in the 3 cities studied.		Surveillance Records	~12,800 reported cases		3		
Espejo et al. 1979	Mexico City, Mexico	1976 - 1978	< 5	Viral	Maximum and minimum temperature (monthly)	Monthly number of rotavirus positive cases among children admitted to two hospitals with diarrhea	No association between the number of hospitalized rotavirus positive patients and minimum or maximum temperature.	Little variability in temperature. Infections peaked in autumn.	Hospital Study	242 infants and young children hospitalized with gastroenteritis				1
Fleury et al. 2006	Alberta and Newfoundland-Labrador, Canada	1992 - 2000	All ages	Bacterial	Average temperature (weekly)	Weekly incidence of laboratory-confirmed infections reported to National Disease Registries *(Salmonella,* pathogenic *E. coli*, and *Campylobacter*)	Significant positive association between temperature and all three bacteria in Alberta, and *Campylobacter* in Newfoundland-Labrador, but not *Salmonella* in Newfoundland-Labrador.	Examined lags of 0-6 weeks. Final model includes a 1-week lag. No pathogenic *E. coli* reported in Newfoundland-Labrador.	Surveillance Records	~20,000 reported cases	4		1	
Glass et al. 1982	Matlab, Bangladesh	1966 - 1980	All ages	Bacterial	Maximum and minimum temperature (monthly)	Culture-positive cholera among hospital diarrhea cases	No clear relationship between monthly maximum and minimum temperature and the number of cases of cholera.	The classical biotype (1966-1972) typically peaked in the cooler winter months but El Tor biotype (1973 - 1980) showed no clear relationship with temperature.	Hospital Surveillance	7,141 cholera patients				1

Supplemental Material, Table S1 (continued) – Ambient Temperature

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size	Direction of Association			
											+	-	0	NA
Gomwalk et al. 1993	Zaria, Nigeria	1986 - 1987	< 6	Viral	Maximum and minimum temperature (monthly)	Monthly prevalence of lab-confirmed rotavirus among clinic patients presenting with AGI	Rotavirus was negatively associated with monthly minimum temperature ($p < .01$) but was not associated with maximum temperature.	No estimates of the association provided, only significance.	Hospital and Clinic Study	392 stool samples examined, 108 positive		1	1	
Haffejee and Moosa 1990	Durban, South Africa	1985 - 1987	< 12	Viral	Average temperature (monthly)	Monthly proportion of lab-confirmed rotavirus among children hospitalized with acute diarrhea	Rotavirus peaked in winter months (May-July), which are cool and dry.	Also saw a minor summer rotavirus peak in 1986.	Hospital Study	1,142 stool samples examined, 624 positive				1
Hall et al. 2011	Australia	2001 - 2002	> 5	All-cause	Average temperature (daily)	Self-reported gastroenteritis in preceding 4 weeks	An average increase of 1° C over the preceding 8 days was associated with a 2.48% increase in self-reported gastroenteritis (HR 1.02, 95% CI 1.01, 1.04).	Random digit dialing survey assessing the prevalence of diarrhea (3 or more loose stools or two vomits in 24 hours) conducted over 12 months.	Community Survey	5,670 people	1			
Hashizume et al. 2007	Dhaka, Bangladesh	1996 - 2002	All ages	All-cause	Average temperature (weekly)	Weekly cases of non-cholera diarrhea presenting to ICDDR,B	An average increase of 1°C over the preceding 4 weeks was associated with a 5.6% increase in cases of non-cholera diarrhea at ICDDR,B (IRR 1.06, 95%CI 1.03, 1.08).	Adjusted for season, between-year variation, holidays, and rainfall. When rotavirus was excluded, the effect of temperature increased to 6.5% (95%CI 1.04, 1.10).	Hospital Surveillance	12,182 diarrhea cases	1			
Hashizume et al. 2008 EI	Dhaka, Bangladesh	1996 - 2001	All ages	Viral	Average temperature (weekly). Calculated as the mean of daily max and min values.	Weekly cases of lab-confirmed rotavirus diarrhea presenting to ICDDR, B.	For a 1°C increase above a threshold of 29°C, there was a 40.2% increase in the risk of a hospital visit for rotavirus diarrhea (IRR 95% CI 1.19, 1.65).	Adjusted for season, holidays, river level, relative humidity, and between-year variation.	Hospital Surveillance	3,115 rotavirus cases	1			
Hashizume et al. 2010	Dhaka, Bangladesh	1983 - 2008	All ages	Bacterial	Average temperature (weekly)	Weekly cases of cholera presenting to ICDDR,B	Positive association between temperature, lagged 0-4 weeks, and the number of cholera cases. 57% of the cases over the study period were attributable to 0-4 week lagged temperature (95% CI 52.4, 60.8%).	Adjusted for seasonality, study period, rainfall, and year.	Hospital Surveillance	10,976 cholera patients	1			

Supplemental Material, Table S1 (continued) – Ambient Temperature

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size	Direction of Association			
											+	-	0	NA
Hu et al. 2007	Brisbane, Australia	1996 - 2004	All ages	Protozoan	Maximum temperature (monthly)	Monthly counts of notified cryptosporidiosis cases	Positive association between maximum temperatures, lagged over 1-3 months, and cryptosporidiosis cases. Predict approximately 50 additional cases per year for a 1°C increase in maximum temperature.	Because this involves the same dataset as Hu et al. 2010, only Hu et al. 2010 was included in quantitative summary of papers.	Surveillance Records	NA	0			1
Hu et al. 2010	Brisbane, Australia	1996 - 2004	All ages	Protozoan	Maximum temperature (weekly)	Weekly counts of notified cryptosporidiosis cases	Positive association between cryptosporidiosis notifications and 1°C increase in 0-8 week lagged weekly maximum temperature.	Same dataset as Hu et al. 2007, but weekly resolution instead of monthly. When CART was tested, high temperature was also associated with increased cryptosporidiosis.	Surveillance Records	NA	1			
Huang et al. 2008	Shenyang, China	1950 - 1996	All ages	Bacterial	Minimum, average, and maximum temperatures (monthly)	Monthly incidence of bacillary dysentery	Minimum, mean, and maximum monthly temperatures positively associated with the monthly incidence of bacillary dysentery.	Authors stratified the analysis into two annual periods: Jan-Jul and Aug-Dec. Similar findings were observed for both periods.	Surveillance Records	NA	3			
Ijaz et al. 1994	Al-Ain, United Arab Emirates	1990 - 1992	Children	Viral	Average temperature (monthly)	Monthly proportion rotavirus-positive stools collected from hospitalized children with diarrhea	Rotavirus seen throughout the year, but more cases seen in cooler months.	No formal analysis presented.	Hospital Study	650 stool samples, 139 positive				1
Islam et al. 2009	Matlab, Bangladesh	1989 - 2005	All ages	Bacterial	Average temperature (monthly)	Monthly cases of cholera at Matlab Hospital, ICDDR,B	Monthly mean temperature positively associated with monthly count of cholera cases.	Classification and regression tree analysis (CART).	Hospital Surveillance	NA	1			
Jagai et al. 2009	Global	1982 - 2005	All ages	Protozoan	Temperature z-score (monthly)	Monthly cryptosporidiosis z-score	A 1-unit change in temperature z-score was associated with an increase in cryptosporidiosis, lagged by 1 month.	Adjusted for distance from the equator. Sub-analysis found variability in estimates for different climate regions.	Meta-analysis	61 studies	1			
Jagai et al. 2012	6 countries in South Asia	1976 - 2009	All ages	Viral	Temperature z-score (monthly)	Monthly rotavirus incidence z-score	A 1-unit change in temperature z-score was associated with a -0.328 unit change in rotavirus incidence z-score, lagged by one month (95% CI -0.558, -0.098).	Adjusted for distance from the equator. In tropical climates, the negative temperature-rotavirus association was not observed under all model scenarios.	Meta-analysis	39 studies		1		

Supplemental Material, Table S1 (continued) – Ambient Temperature

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size	Direction of Association			
											+	-	0	NA
Katsumata et al. 1998	Surabaya, Indonesia	1992 - 1993	All ages	Protozoan	Average temperature (monthly)	Monthly proportion-positive *Cryptosporidium* stools among people with/ without diarrhea	No clear association between *Cryptosporidium* and temperature.	Temperature relatively constant throughout the study period.	Hospital Study	917 patients with diarrhea (26 positive), 1,043 in-patient controls (15 positive)				1
Kelly-Hope et al. 2007	Vietnam	1991 - 2001	All ages	Bacterial	Average temperature (annual)	Average annual incidence of shigellosis, typhoid and cholera by province from the National Institute of Hygiene and Epidemiology in Hanoi	Significant positive correlation between temperature and typhoid fever, but no association between temperature and Cholera or *Shigella* in bivariate analysis. Temperature is not included in the final multivariate model.	Same dataset as Kelly-Hope et al., 2008. Temperature measure not clearly defined but because used an annual temperature measure, excluded from quantitative analysis.	Surveillance Records	435,037 shigellosis cases; 187,318 typhoid cases; 17,385 cholera cases	0		0	1
Kelly-Hope et al. 2008	Vietnam	1991 - 2001	All ages	Bacterial	Average temperature (monthly)	Monthly incidence of shigellosis, typhoid and cholera by region, dichotomized to high and low periods	Generally warmer in high vs. low incidence periods for all three pathogens, but no estimates of significance reported.	Same dataset as Kelly-Hope 2007. Sparse information on temperature. Focus on significant rainfall associations.	Surveillance Records	435,037 shigellosis cases; 187,318 typhoid cases; 17,385 cholera cases				1
Kimura et al. 2005	Kathmandu, Nepal	1999 - 2002	All ages	Protozoan	Average temperature (monthly)	Monthly *Cyclospora*-positive stools from people with diarrhea	Highest percent of positive samples seen in summer (June - August), which is warm and rainy. Few cases in cooler, dry months, with the exception of a high percent positive in December.	Also tested 686 samples from Lao PDR, but only 1 positive. Excluded from analysis. Samples from hospitals, labs and schools.	Hospital and Community Study	1,397 stool samples, 128 positive				1
Konno et al. 1983	Yamagata, Japan	1974 - 1981	< 15	Viral	Average temperature (monthly)	Proportion of monthly rotavirus-positive stools from pediatric patients with acute diarrhea	Peak of infections observed in coldest months when average 10 day temperatures <5°C. Very little disease when temperatures >20°C.		Hospital Study	1,910 patients, 859 positive				1

Supplemental Material, Table S1 (continued) – Ambient Temperature

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size	Direction of Association			
											+	-	0	NA
Kovats et al. 2004	10 countries in Europe	1983 - 2002; varied by country	All ages	Bacterial	Average temperature (weekly, except Poland (biweekly), Estonia and Slovak Republic (monthly))	Weekly cases of Salmonellosis, except Poland (biweekly), Estonia and Slovak Republic (monthly)	Significant positive association between temperature and *Salmonella* for 7 of 10 countries. Above the common threshold for all countries of 6°C, a 1°C increase in temperature was associated with a 0.3% to a 12.5% increase in *Salmonella* cases.	No significant association between temperature and S*almonella* in Denmark, Estonia and Slovak republic. The latter two countries had monthly resolution.	Surveillance Records	NA	7		3	
Kovats et al. 2005	6 countries in Europe	1989 - 2002; varied by country	All ages	Bacterial	Average temperature (weekly)	Peak weak -- the week with the maximum number of *Campylobacter* cases each year	The timing of the annual peak in cases was not significantly associated with temperature at a 0-4 week lag.	Also found warmer mean summer and winter temperatures associated with earlier annual peak in C*ampylobacter* cases. Authors looked at lags up to 29 weeks.	Surveillance Records	~580,000 cases			1	
Lake et al. 2005	England and Wales	1989 - 1996	All ages	Protozoan	Average temperature (monthly)	Monthly rate of reported cryptosporidiosis cases (monthly cases/number of days in the month)	1°C increase in preceding month was associated with a 2.09 unit increase in the cryptosporidiosis rate from August to November. No association between temperature and cryptosporidiosis during December-March and April-July.	Analysis was separated into 3 four-month periods.	Surveillance Records	~52,000 reported cases	1		2	
Lama et al. 2004	Lima, Peru	1991 - 1998	$\geq$ 13	All-cause	Average temperature (monthly)	Monthly number of patients in the emergency room for acute diarrhea	1°C increase in mean monthly temperature was associated with an 11.3% increase in the number of acute diarrhea cases when cholera was absent in the community and 20.3% when cholera was present.		Hospital Records	~40,000 acute diarrhea cases	1			
Lee et al. 2012	Southern Taiwan	2002 - 2008	Children	Viral	Average temperature (monthly)	Monthly proportion of children with rotavirus among those hospitalized for acute gastroenteritis	Negative correlation between mean temperature and rotavirus (r=-0.84).	Also report on non-typhoidal *Salmonella,* but no analysis of the relationship between temperature and *Salmonella*.	Hospital Records	2,040 patient charts reviewed, 541 positive for rotavirus		1		

Supplemental Material, Table S1 (continued) – Ambient Temperature

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size	Direction of Association			
											+	-	0	NA
Levy et al. 2009	Global Tropics	1974 - 2005	All ages	Viral	Average temperature (monthly)	Monthly cases of rotavirus	A 1°C increase in average monthly temperature is associated with a 10% decrease in rotavirus cases in the tropics.	Adjusted for autocorrelation.	Meta-analysis	26 studies		1		
Lloyd et al. 2007	Global	1954 - 2000; varied by source	< 5	All-cause	Mean of average monthly temperature across the study period for each report	Estimates of diarrhea incidence from three diarrhea burden of disease reviews	No significant association between temperature and diarrhea in children under 5.	Excluded from quantitative analysis because temperature was calculated over several months.	Meta-analysis	36 studies from 3 published reviews			0	1
Lopman et al. 2009	England and Wales	1993 - 2006	All ages	Viral	Average temperature (daily)	Daily reported laboratory-confirmed norovirus infections	Norovirus reports decreased by 15% for each 1°C average increase in temperature over the preceding 49 days.		Surveillance Records	35,210 reported cases		1		
Luque Fernandez et al. 2009	Lusaka, Zambia	2003 - 2006	All ages	Bacterial	Maximum temperature (weekly)	Number of cholera cases per week at cholera isolation centers	1°C increase in temperature is associated with a 5% increase in cholera cases 6 weeks later.	Adjusted for rainfall and autocorrelation. Data collected during three cholera outbreaks.	Surveillance Records	~13,000 cases	1			
Matsuda et al. 2008	Dhaka, Bangladesh	1983 - 2002	< 10	Bacterial	Maximum and minimum temperature (monthly)	Monthly cases of cholera 01	Cholera cases are negatively associated with maximum temperature 2 months prior and minimum temperature 4 months prior.	Adjusted for rainfall and autocorrelation.	Hospital Records	153,775 cholera cases		2		
McCormick et al. 2012	Thailand	2003 - 2006	All ages	All-cause	Average temperature (monthly)	Monthly incidence of hospitalizations due to acute diarrhea	Acute diarrhea positively associated with mean daytime temperature in the current month. The association was strongest in lower income regions.	A model including temperature lags at 0, 9 & 10 months explained 54.4% of the variation in monthly diarrhea cases.	Surveillance Records	NA	1			
Mitui et al. 2011	Hong Kong, China	2004 - 2007	All ages	Viral	Average temperature (monthly)	Monthly rotavirus-positive cases	Most rotavirus cases in cooler, winter months (Nov - March).		Hospital Study	6,937 patients with diarrhea, 830 positive for rotavirus				1

Supplemental Material, Table S1 (continued) – Ambient Temperature

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size	Direction of Association			
											+	-	0	NA
Naumova et al. 2007	Massachusetts, USA	1992 - 2001	All ages	Multiple	Average temperature (daily)	Daily reported lab-confirmed cases of *Campylobacter, Salmonella, Shigella, Cryptosporidium* and *Giardia*	Salmonellosis and campylobacteriosis peak with temperature. *Shigella, Cryptosporidium,* and *Giardia* peak in the fall, lagging behind the temperature peak.	Authors selected diseases that typically peak in summer or autumn and are water-borne.	Surveillance Records	45,816 reported cases				1
Onozuka et al. 2010	Fukuoka, Japan	1999 - 2007	All ages	All-cause	Average temperature (weekly)	Weekly cases of infectious gastroenteritis in 120 sentinel medical institutions	For each 1°C weekly mean temperature increase, a 7.7% increase in cases of infectious gastroenteritis was observed.	Adjusted for seasonality, autoregression, relative humidity, and long-term trends (year).	Surveillance Records	422,176 reported cases	1			
Paredes-Paredes et al. 2011	Cuernavaca, Mexico	2006 - 2007	Adults	Bacterial	Average temperature (weekly)	Weekly percent of diarrhea stools positive for pathogenic *E. coli*	Higher incidence of diarrhea and *E. coli* in summer vs. winter months. Significant relationship between temperature and ETEC, but not EAEC.	Enrolled foreign students in summer (May-Aug) and winter (Jan-Feb). Look at 5 different *E. coli* serotypes but only two formally tested for an association with temperature.	Cohort Study	515 people enrolled, 152 stool samples examined	1		1	
Phukan et al. 2003	Dibrugarh, Northeast India	1999 - 2000	< 5	Viral	Maximum and minimum temperature (monthly)	Monthly incidence of rotavirus diarrhea in hospitalized children with acute diarrhea	Incidence of rotavirus highest in coolest month.		Hospital Study	202 children, 47 rotavirus positive				1
Pinfold et al. 1991	Northeast Thailand	1982 - 1987	All ages	All-cause	Average temperature (monthly)	Monthly incidence of all-cause acute diarrhea	Inverse association between monthly average temperature and incidence of all-cause diarrhea.	Diarrhea peaked during dry season and at the beginning of the rainy season. Authors note shift in drinking water sources in rainy vs. dry season.	Surveillance Records					1
Purohit et al. 1998	Pune, India	1992 - 1996	< 5	Viral	Minimum temperature (monthly)	Monthly rotavirus-positive cases in a diarrhea ward	Inverse association between monthly rotavirus-positive cases and monthly minimum temperature.		Hospital Study	2,267 samples, 945 positive				1
Ram et al. 1990	Ludhiana, India	1984 - 1987	All ages	Bacterial	Maximum and minimum temperature (monthly)	Monthly percent of stool samples positive for enteroinvasive *E. Coli*	Positive association between maximum and minimum temperature and the percent of samples positive for pathogenic *E. coli*.		Hospital Study	2,661 samples, 57 positive	2			
Salazar-Lindo et al. 1997	Lima, Peru	1993 - 1997	Infants and young children	All-cause	Average temperature (monthly)	Monthly admissions for diarrhea and dehydration	Positive association between montly mean temperature and diarrhea admissions.	High temperatures during El Niño period accompanied by high rates of diarrhea admissions.	Hospital Records					1

Supplemental Material, Table S1 (continued) – Ambient Temperature

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size	Direction of Association			
											+	-	0	NA
Sarkar et al. 2013	Vellore, South India	2002 - 2006	< 3	Viral	Average temperature (weekly)	Weekly rotavirus incidence	Temperature is significantly associated with rotavirus incidence, interaction with humidity.	One of the few papers with non-hospital incidence measure for rotavirus.	Cohort study	452 children	1			
Seidu et al. 2013	Northern Ghana	2008 - 2009	All ages	All-cause	Maximum and minimum temperature (biweekly)	24-hour, self-reported diarrhea incidence recorded during bi-weekly interviews	Maximum temperature positively associated with diarrhea in communities that use sludge and negatively associated with diarrhea in communities that do not use sludge. Opposite relationship observed for minimum temperature.	Maximum and minimum temperatures are included in the same model.	Cohort Study	2,664 residents of sludge and non-sludge communities	2	2		
Singh et al. 2001	Fiji	1978 - 1998	Infants	All-cause	Average temperature (monthly)	Average monthly rate of diarrhea in infants	Positive association between monthly temperature and diarrhea one month later.	Also found positive association between average annual temperature for a country and the annual rate of diarrhea among people of all ages across 18 Pacific islands.	Surveillance Records	NA	1			
Soenarto et al. 1981	Yogyakarta, Indonesia	1978 - 1979	< 12	Viral	Average temperature (daily)	Monthly proportion rotavirus-positive stools among children hospitalized with acute gastroenteritis	No association between temperature and rotavirus.	Temperature varied little throughout the study period.	Hospital Study	532 patients, including 188 controls and 334 with acute gastroenteritis				1
Speelmon et al. 2000	Lima, Peru	1997 - 1999	All ages	Bacterial	Average temperature (weekly)	Weekly cases of cholera reported to the Ministry of Health	Positive correlation between weekly ambient temperature and reported cholera cases (r=0.49, p<0.001).		Surveillance Records	1,175 cholera cases	1			
Sumi et al. 2013	Kolkata, India	2007 - 2009	All ages	Viral	Average temperature (monthly)	Monthly proportion of patients hospitalized with diarrhea that are rotavirus positive	Higher proportion of rotavirus-positive samples at lower temperatures.		Hospital Records	2,519 samples				1
Sutra et al. 1990	Khon Kaen Province, Thailand	1988 - 1989	< 5	All-cause	Average temperature (monthly)	Monthly number of cases of diarrhea	No clear association between monthly mean temperature and monthly diarrhea cases.	Two diarrhea peaks: at the beginning of the rainy season (May-June) and in the cold season (Nov-Jan).	Cohort Study	481 children				1

Supplemental Material, Table S1 (continued) – Ambient Temperature

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size	Direction of Association			
											+	-	0	NA
Tam et al. 2006	England	1989 - 1999	All ages	Bacterial	Average temperature (weekly)	Weekly reported *Campylobacter* cases	For each 1°C increase in mean weekly temperature, there was a 5% increase in the number of *Campylobacter* cases up to a threshold of 14°C.	Adjusted for seasonality, long-term trends, public holidays, and relative humidity.	Surveillance Records	623,817 cases	1			
Torres et al. 1978	Caracas, Venezuela	1975 - 1976	< 5	Viral	Average temperature (monthly)	Monthly proportion rotavirus-positive stools among hospitalized children	Modest negative relationship between monthly temperature and the proportion of samples positive for rotavirus.	Very little variation in monthly mean temperature throughout the study period.	Hospital Study	293 acute gastroenteritis patients, 66 controls hospitalized for other reasons				1
Trabelsi et al. 2010	Coastal Tunisia	2000 - 2003	< 5	Viral	Average temperature (monthly)	Monthly rate of rotavirus detection	Rotavirus negatively associated with temperature.	Combination of hospital and clinic-based sampling makes the outcome difficult to interpret.	Hospital Study	309 stool samples from outpatients with gastroenteritis and hospitalized children				1
Traerup et al. 2011	Tanzania	1998 - 2004	All ages	Bacterial	Maximum temperature (monthly)	Monthly reported cholera cases	A 1°C increase in average monthly temperature was associated with a 29% increase in the relative risk of cholera.	Also examine relationship between annual temperature and cholera cases	Surveillance Records	NA	1			
Utsalo et al. 1992	Calabar, Nigeria	1989	All ages	Bacterial	Average temperature (monthly)	Monthly count of diarrhea outpatients positive for *V. cholerae* and *V. parahemolyticus* infection	Positive association between mean monthly temperature and *Vibrio* spp. diarrhea count.	Little variation in temperature throughout the study period.	Hospital Study	881 outpatients with acute diarrhea, 33 with V*ibrio* infections				1
Woodward et al. 1974	Fort Apache Reservation, USA	1968 - 1971	< 3.5	All-cause	Average temperature (monthly)	Monthly diarrhea attack rate	Highest diarrhea rates at the end of summer. More closely associated with rainfall than temperature.		Hospital Study	741 child charts reviewed, 573 had diarrhea				1
Workman et al. 2006	Barbados	2000 - 2003	All ages	Bacterial	Average temperature (monthly)	Number of *Campylobacter* cases from stools of those submitted to a public health laboratory	No association was observed between the incidence of *Campylobacter* and temperature.	Type of temperature measure not specified	Surveillance Records	78 cases			1	

Supplemental Material, Table S1 (continued) – Ambient Temperature

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size	Direction of Association			
											+	-	0	NA
Zhang et al. 2008	Jinan, China	1987 - 2000	All ages	Bacterial	Maximum temperature (monthly)	Monthly reported cases of bacillary dysentery	11% increase in reported bacillary dysentery cases for each 1ºC increase in maximum temperature adjusting for seasonality and autocorrrelation.	Minimum temperature regression results not presented, but authors state results are "very similar" to maximum temperature results.	Surveillance Records	60,905 bacillary dysentery cases	1			
Zhang et al. 2010	Brisbane and Townsville, Australia	1990 - 2005	All ages	Bacterial	Maximum and minimum temperatures (Brisbane: weekly; Townsville: monthly)	Weekly (Brisbane) and monthly (Townsville) notified cases of *Salmonella* infection	Weekly and monthly maximum and minimum temperature are positively associated with reported *Salmonella* cases in Brisbane and Townsville, respectively, after adjusting for rainfall, seasonality, and year.	In text, present % change as absolute value of coefficient rather than exp (coef).	Surveillance Records	5,294 cases in Brisbane, 1,170 in Townsville	4			

Supplemental Material, Table S2a: Articles included in the systematic review of the relationship between heavy rainfall and diarrheal diseases—systematically collected datasets. Direction of association columns indicate the number of analyses presented by the authors of the article that resulted in a positive ("+"), negative ("-"), or neutral ("0") association between exposure of interest and outcome, based on statistical analysis. Positive or negative relationships were defined as $p<0.05$ or 95% CI did not include the null. "NA" indicates article did not present results of a statistical analysis.

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size	Direction of Association			
											+	-	0	NA
Adkins et al. 1987	Manila, Philippines	1983 - 1984	< 50	Multiple	Monsoon rains, months with maximum rainfall	Hospital diarrhea admissions for pathogen specific diarrhea	Diarrhea rates increased with the onset of the monsoon rains and peaked during the months of maximum rainfall. *V. cholerae* especially peaked during peak rainfall months.	Weather patterns in 1983 were atypical (drought conditions early in the year, rainy season was delayed 2 months).	Case-control study	2,908 cases, 576 controls				1
Carlton et al. 2014	Esmeraldas Province, Ecuador	2004 - 2007	All ages	All-cause	24-hr rainfall exceeding the 90th percentile value (56 mm)	Weekly diarrhea incidence via household survey	Heavy rainfall was associated with an increase in diarrhea incidence during dry periods IRR=1.39 (95% CI: 1.03, 1.87) and a decrease during wet periods IRR=0.74 (95% CI:0.59, 0.92) at a 2-week lag.	Controlled for diarrhea incidence during the week prior, and for village remoteness.	Cohort study	5,170 individuals ; 19 villages	1	1		
Chou et al. 2010	Taiwan	1996 - 2007	All ages	All-cause	Daily rainfall > 40 mm	Monthly incidence of hospital admissions for all-cause diarrhea from National Health Insurance Research database	Association of extreme rainfall days with monthly diarrhea morbidity at a 2-month lag IRR=1.004 (95% CI: 1.000, 1.008).	Controlled for maximum temperature (lag 1 month), humidity (no lag), seasonality, and month in final model.	Health insurance records	1.2 million cases of diarrhea	1			
Curriero et al. 2001	USA	1948 - 1994	All ages	All-cause	Extreme rainfall, determined by the highest z-score for each watershed's total monthly precipitation	Waterborne disease outbreak	51% of outbreaks preceded by precipitation above 90th percentile (p=0.002); 68% of outbreaks preceded by precipitation above 80th percentile (p=0.001).	Data from EPA Waterborne disease database and National Climatic Data Center.	Surveillance records	525 outbreaks	1			
Dewan et al. 2013	Dhaka, Bangladesh	2005 - 2009	All ages	Bacterial	Monsoon months	Weekly number of typhoid cases admitted to 11 hospitals	Significant positive association between rainfall above 77mm and typhoid cases at lags of 0-3 weeks. Almost half (45%) of cases occurred during monsoon months.	Also found 4.6% increase in typhoid cases for every 0.1m increase in river level.	Hospital records	4,355 typhoid cases	1			

Supplemental Material, Table S2a (continued) – Heavy Rainfall – systematically collected datasets

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size	Direction of Association			
											+	-	0	NA
Drayna et al. 2010	Wisconsin, USA	2002 - 2007	≤ 18	All-cause	Extreme precipitation defined as > 95th percentile rainfall (> 2.54 cm in a 24-hr period or 3.76 cm in a 48-hr period)	Daily emergency department (ED) visits for AGI	No significant difference found between heavy rainfall events and AGI ED visits at lags of 1-7 days.	Also found that any rainfall 4 days prior was significantly associated with an 11% increase in AGI visits.	Hospital records	17,357 AGI ED visits			1	
Glass et al. 1982	Matlab, Bangladesh	1966 - 1980	All ages	Bacterial	Peak rainfall or the onset of the monsoon	Culture-positive cholera among hospital diarrhea cases	No observed relationship between peak rainfall or onset of the monsoon with timing of the annual cholera epidemic.		Hospital surveillance	7,141 cholera patients				1
Hashizume et al. 2007	Dhaka, Bangladesh	1996 - 2002	All ages	All-cause	10-mm increase or decrease over threshold rainfall value (52mm)	Weekly number of non-cholera diarrhea patients presenting to ICDDR,B	Diarrhea cases increased by 5.1% (95% CI: 3.3, 6.8%) and 3.9% (95% CI: 0.6, 7.2%), respectively, for a 10-mm increase and decrease above or below the rainfall threshold (52 mm). High rainfall effect observed at 1-5 weeks; Low-rainfall effect observed at 0 and 10-16 weeks.	Linear threshold model controlled for seasonal and between-year differences, public holidays, and temperature.	Hospital surveillance	12,182 diarrhea cases	1	1		
Hashizume et al. 2008 Epi	Dhaka, Bangladesh	1996 - 2002	All ages	Bacterial	10-mm increase or decrease over threshold rainfall value (45mm)	Weekly number of culture-positive cholera patients among hospital diarrhea cases	Cholera cases increased by 14% (95% CI: 10.1, 18.9%) and 24% (95% CI: 11.3, 38.9%), respectively, for a 10-mm increase or decrease above or below the rainfall threshold (45 mm). High rainfall effect observed at 1-5 weeks; Low-rainfall effect observed at 1-16 weeks.	Linear threshold model controlled for seasonal and between-year differences, public holidays, and temperature.	Hospital surveillance	3,807 cholera cases	1	1		

Supplemental Material, Table S2a (continued) – Heavy Rainfall – systematically collected datasets

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size	Direction of Association			
											+	-	0	NA
Nichols et al. 2009	England and Wales	1910 - 1999	All ages	All-cause	Rainfall exceeding the upper limit of the 95% reference range 4 weeks prior to outbreak	Drinking-water related outbreaks	Significant association between excess cumulative rainfall in the previous 7 days and outbreaks (p=0.001).	Also found significant association between low rainfall in the previous 2-4 weeks and outbreaks (p=0.002).	Systematic review of outbreaks	89 outbreaks	1			
Said et al. 2003	England and Wales	1970 - 2000	All ages	All-cause	Heavy rainfall	Outbreaks of private drinking water supplies	Heavy rainfall preceded or occurred concurrently with 24% of outbreaks.		Systematic review of outbreaks	25 outbreaks				1
Seidu et al. 2013	Northern Ghana	2008 - 2009	All ages	All-cause	Bi-weekly maximum rainfall	Diarrhea in the past 24 hours reported during bi-weekly interviews	Maximum rainfall events associated with increased risk of diarrhea in both sludge (RR=1.03; 95% CI: 1.02, 1.05) and non-sludge (RR=1.003; 95% CI: 0.99, 1.01) communities.	Examined farming communities that apply fecal sludge and those that do not.	Cohort Study	2,664 residents	2			
Thomas et al. 2006	Canada	1975 - 2001	All ages	All-cause	Maximum 5-day rainfall in a six-week period, as a percentile of the annual average.	Waterborne disease outbreak	Increased risk of outbreaks following rainfall events above the 93rd percentile (OR= 2.28; 95% CI: 1.22, 4.29).	Controlled for temperature. Using a step-wise selection procedure, absolute accumulated rainfall and accumulated rainfall days were not retained in the final model.	Analysis of outbreak database	92 outbreaks	1			

Supplemental Material, Table S2b: Articles included in the systematic review of the relationship between heavy rainfall and diarrheal diseases—outbreak reports.

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusions	Noted Associations with Heavy Rainfall	Environmental Investigations	Data Source	Study Size
Aksoy et al. 2007	Western Turkey	2005	All ages	Protozoan	Residence in Izmir	Laboratory-confirmed cryptosporidiosis and cyclosporiasis	The suspected source of the outbreak was the public drinking water supply contaminated by sewage or animal waste following heavy rainfall.	Unusually heavy rainfall is thought to have caused contamination of the water supply with sewage.	Coliform bacteria detected in water tank. No detectable chlorine in water tank.	Outbreak investigation	22 cases
Anderson et al. 2003; Gelting et al. 2005	Wyoming, USA	2001	All ages	Viral	Visiting a mountain lodge	AGI; norovirus	Significant association between water consumption and illness; dose response relationship observed.	Along with infrastructure problems, heavy rains preceding the start of the outbreak helped carry wastewater across bedrock to wells.	Well water samples tested positive for fecal coliforms; identical norovirus sequence was isolated from well water and 6 stool samples.	Outbreak investigation	35 AGI cases
Atherton et al. 1995	Bradford, England	1992	All ages	Protozoan	Living within or visiting the distribution zone of the suspected plant and consumption of unboiled tap water.	Laboratory-confirmed cryptosporidiosis	Cases significantly more likely than controls to have consumed unboiled tap water and reside in supply zone, and those drinking larger volumes of water were more likely to become ill.	Heavy rainfall in the catchment area of the reservoir immediately prior to outbreak. Increased turbidity of finished water also noted.	*Cryptosporidium* oocysts detected at the treatment plant and in the distribution system at low concentrations during early stages of the outbreak. Replacement of a sand filter within the waterworks at the time of heavy rains reduced the efficiency of the water treatment.	Outbreak investigation	125 cases
Auld et al. 2004; CCDR 2000	Walkerton, Canada	2000	All ages	Bacterial	Consumption of Walkerton municipal water	Reported gastroenteritis, laboratory-confirmed *E. coli* O157:H7 and *Campylobacter*	People residing in homes connected to municipal water supply had 11.7 times higher gastroenteritis risk; dose response relationship observed.	Record high monthly rainfall led to ground saturation, increasing the groundwater contamination risk. Contamination of well water was likely responsible for gross contamination of the distribution system.	Coliform bacteria and *E. coli* detected in the municipal water distribution system. First documented outbreak of *E. coli O157:H7* in a municipal water supply in Canada and the largest recorded multi-bacterial waterborne outbreak in Canada.	Outbreak investigation	1,346 cases of gastroenteritis

Supplemental Material, Table S2b (continued) – Heavy Rainfall – outbreak reports

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusions	Noted Associations with Heavy Rainfall	Environmental Investigations	Data Source	Study Size
Bridgman et al. 1995	Warrington, England	1992 - 1993	All ages	Protozoan	Residence in an area supplied by two groundwater sources; drinking unboiled tap water from these sources	Laboratory-confirmed cryptosporidiosis	Drinking water from a zone of the distribution system supplied from groundwater sources was significantly associated with cryptosporidiosis.	Very heavy rainfall preceding outbreak. One source of water drained surface water directly from a field containing livestock feces, bypassing natural sandstone filtration. Also high turbidity in associated distribution reservoir associated with this zone.	*Cryptosporidium* oocysts were not detected in the water supply.	Outbreak investigation	47 cases
Doyle et al. 2004	Etang de Thau, France	2002	All ages	Viral	Consumption of raw oysters from Etang de Thau	Presence of diarrhea and/or vomiting, or fever or abdominal pains and/or nausea within 72 hours of oyster consumption	Those consuming raw oysters from the supply in question were significantly more likely to experience illness than those not exposed.	Unusually heavy rainfall and flooding occurred at the site of oyster harvest immediately prior to the outbreak.	Reports of overflow of wastewater treatment plants and pumping stations. High levels of *E. coli* contamination of water and bacteriological contamination of shellfish.	Outbreak investigation	69 cases
Effler et al. 2001	Swaziland	1992 - 1993	> 5	Bacterial	Consumption of untreated water or beef consumption, female gender	*E. coli* O157:NM	Drought, carriage of *E. coli* O157 by cattle, and heavy rains with contamination of surface water appear to be important factors contributing to this outbreak. Untreated water and beef consumption and female gender was associated with diarrheal illness.	Outbreak of E. coli O157:NM 3 days after first heavy rainfalls following 3 months of drought. 72-75% of monthly rainfall fell in one day.	*E. coli* O157 was isolated from water, sewage, cattle, and maize samples. Authors speculate that contamination of scarce water sources by livestock led to outbreak. A 7-fold increase in cattle deaths was also noted.	Outbreak investigation	> 2,868 diarrhea cases

Supplemental Material, Table S2b (continued) – Heavy Rainfall – outbreak reports

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusions	Noted Associations with Heavy Rainfall	Environmental Investigations	Data Source	Study Size
Fong et al. 2007; O'Reilly et al. 2007	Ohio, USA	2004	All ages	Multiple	Consumption of tap water	Gastroenteritis	Significant association between gastroenteritis symptoms and tap water consumption, as well as the amount of tap water consumed. Groundwater contamination was likely caused by transport of microbiological contaminants after extreme precipitation events.	Extreme precipitation events likely raised the water table, saturated the subsurface, and along with very strong Lake Erie currents, forced a surge in water levels and rapid surface water-groundwater interchange.	Municipal wastewater system was functioning properly. Well water was contaminated with multiple microbial pathogens including *C. jejuni, Salmonella* and *Giardia*. Contamination caused by fecal contamination of karst aquifer.	Outbreak investigation	1,450 cases
Goodman et al. 1982	Georgia, USA	1982	All ages	Viral	Homes served by the community water system	AGI; Norwalk virus	Homes served by the public water system were significantly more likely to have reported AGI than those with private supplies. Four-fold rise in antibody titer to Norwalk virus among patients.	Approximately 4.5 inches of rainfall over 2 days immediately preceding the outbreak. Surface water from heavy rainfall may have contaminated the system.	Fecal coliforms detected in spring feeding the community water system. Spring was open to groundwater runoff from nearby homes with septic tanks and animals. A well casing was subjected to flooding by surface water.	Outbreak investigation	59 AGI cases
Hejkal et al. 1982	Texas, USA	1980	All ages	Viral	Central city well water supply	AGI; Hepatitis A	The outbreak may have been caused by fecal contamination of groundwater near the central-city wells.	The outbreak occurred following a period of heavy rainfall. Another outbreak in 1979 in this region was also preceded by heavy rainfall.	Hepatitis A virus was detected in sewage and well water, despite sufficient chlorine residual. Rotavirus detected in sewage samples only. No viruses detected in stool samples.	Outbreak investigation	Approximately 7,900 AGI cases, 29 hepatitis A cases
Ihekweazu et al. 2006	Cornwall, England	2004	1-10 years	Bacterial	Contact with a freshwater stream flowing across a seaside beach	Laboratory confirmed *E. coli* O157	Cases had higher exposure to streams than controls; a dose-response effect was observed.	Heavy rainfall in the days preceding the outbreak might have caused feces from the cattle, potentially containing *E. coli* O157, to contaminate the stream.	Increased numbers of coliforms were found in the stream prior to the outbreak. Cattle were found grazing upstream.	Outbreak investigation	7 cases

Supplemental Material, Table S2b (continued) – Heavy Rainfall – outbreak reports

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusions	Noted Associations with Heavy Rainfall	Environmental Investigations	Data Source	Study Size
Mackenzie et al. 1994; Fox and Lytle 1996	Wisconsin, USA	1993	All ages	Protozoan	Receiving water from the southern Milwaukee treatment plant	Watery diarrhea; cryptosporidiosis	Outbreak was caused by *Cryptosporidium* oocysts that passed through the filtration system of one of the city's water-treatment plants. The rates of isolation of other enteric pathogens remained stable but there was >100-fold increase in the rate of isolation of *Cryptosporidium*.	Before the outbreak, severe spring storms caused the lake's turbidity and bacterial counts to rise dramatically. There were marked increases in the turbidity of treated water at the city's southern water-treatment plant.	*Cryptosporidium* oocysts were identified in water from ice made in southern Milwaukee. Largest U.S. waterborne disease outbreak to date.	Outbreak investigation	Estimated 403,000 cases with watery diarrhea
Millson et al. 1991	Ontario, Canada	1985	All ages	Bacterial	Consumption of town water	Vomiting and/or diarrhea; laboratory-confirmed *Campylobacter jejuni*	Heavy rainfall and detection of well water contamination was followed by an increase in illness. Higher average consumption of town water by *C. jejuni* cases.	Especially heavy snow accumulation, with a correspondingly heavy spring runoff, accompanied by heavy rainfall. Outbreak attributable to melt water entering municipal wells.	No environmental sampling reported. Water in the system was not chlorinated because chlorination was not required for deep well systems.	Outbreak investigation	241 AGI cases; 57 *C. jejuni* cases
Patil et al. 2011	Delhi, India	2009	All ages	All-cause	Residence in a labor settlement at a construction site	Acute watery diarrhea	Well water was the probable source of infection, with contamination occurring as the result of open defecation.	Heavy rains occurred two days prior to the onset of the outbreak.	3 of 7 water samples (and 3 of 15 stool samples) were positive for *V. cholerae* 01.	Outbreak investigation	69 cases
Smith et al. 1989	Ayrshire, Scotland	1988	All ages	Protozoan	Residence in Ayrshire	Laboratory-confirmed cryptosporidiosis	Oocyst contamination of a break-pressure tank containing final water for distribution was the cause of the outbreak.	Outbreak was preceded by a period of heavy rainfall. Three very wet days following a dry period.	*Cryptosporidium* oocysts were detected in the chlorinated water supply system. Indicators of fecal contamination detected in the distribution system and neighboring stream near the break-pressure tank.	Outbreak investigation	27 cases

Supplemental Material, Table S2b (continued) – Heavy Rainfall – outbreak reports

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusions	Noted Associations with Heavy Rainfall	Environmental Investigations	Data Source	Study Size
Vogt et al. 1982	Vermont, USA	1978	All ages	Bacterial	Consumption of unboiled water from the town water system	AGI; *Campylobacter jejuni*	People who consumed unboiled Bennington water had a significantly higher illness rate than those who consumed water from another source. Dose-response effect observed.	Heavy rainfall occurred several days before the outbreak and subsequent increases in water turbidity were noted.	No water samples or specimens from wild or domestic animals were positive for *Campylobacter*. Absence of filtration made it difficult to maintain adequate chlorine levels.	Outbreak investigation	169 cases out of approximately 1,100 survey respondents
Willocks et al. 1998	North Thames, UK	1997	All ages	Protozoan	Consumption of unboiled tap water, and/or water from a water treatment works	Laboratory-confirmed cryptosporidiosis	Cases were more likely to have consumed unboiled tap water. Source suspected to be a deep chalk borehole.	Unusually heavy rains immediately prior to the outbreak followed a period of 2 years of very little rainfall.	19 of 582 water samples tested positive for *Cryptosporidium*, including the suspected borehole well. The implicated well was next to a cattle farm.	Outbreak investigation	345 cases
Yamamoto et al. 2000	Ogose Town, Japan	1996	All ages	Protozoan	Town residents and visitors	Diarrhea, abdominal cramps, and/or lab-confirmed cryptosporidiosis	Outbreak caused by contamination of the town's potable water system by *Cryptosporidium* oocysts following a high rainfall event after a low rainfall period.	Low monthly precipitation in May followed by a heavy rainfall event that increased water turbidity. Outbreak occurred in June.	No environmental sampling reported.	Outbreak investigation	9,140 cases

Supplemental Material, Table S3a: Articles included in the systematic review of the relationship between flooding and diarrheal diseases—studies with an explicitly defined comparison group. Direction of association columns indicate the number of analyses presented by the authors of the article that resulted in a positive ("+"), negative ("-"), or neutral ("0") association between exposure of interest and outcome, based on statistical analysis. Positive or negative relationships were defined as $p<0.05$ or 95% CI did not include the null. "NA" indicates article did not present results of a statistical analysis.

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size	Direction of Association			
											+	-	0	NA
Biswas et al. 1999	West Bengal, India	1993	All ages	All-cause	Flooding of Hooghly District	Self-reported diarrhea	The attack rate for diarrhea increased from 4.5% to 17.6% ($p<0.01$) following the flood.		Community survey	398 people surveyed	1			
Bokhari et al. 2013	Pakistan	2010 - 2011	> 15	Bacterial	2010 and 2011 floods	Patients with diarrhea-like symptoms	Higher proportion of diarrhea cases attributable to pathogenic *E. coli* in flood-affected areas (56.3%) compared with sporadic cases from non-flood affected areas (12.5%) in the same provinces during similar time periods.	Tested stools from 205 patients from flooded and 400 patients from non-flooded areas.	Hospital study	605 diarrhea patients				1
Campanella 1999	Villanueva, Nicaragua	1998	All ages	All-cause	Flooding caused by Hurricane Mitch	30-day incidence of diarrhea in the affected region	Incidence increased by 910 cases/100,000 population from the same month in the previous year ($p<0.01$).		Clinic records	25,300 residents	1			
CDC 2000	North Carolina, USA	1999	All ages	All-cause	Flooding caused by Hurricane Floyd	Weekly diarrheal ED visits a month after the hurricane	RR=2.0 (95% CI: 1.4, 2.8) for diarrhea a month after Hurricane Floyd vs. the same period in the prior year.	Several rivers flooded and 2.1 million people were estimated to be affected.	Hospital records	53,398 ED visits	1			
CDC 2005d	Thailand	2004 - 2005	All ages	All-cause	Flooding caused by a tsunami	Acute diarrhea reported by medical facilities	Authors report a 1.7-fold increase in annualized rate of diarrhea relative to the same period in the preceding year, but do not test this association.	Reported increase in diarrhea rate is confounded by a shift from passive surveillance to active surveillance immediately following the tsunami.	Surveillance records	1,237 diarrhea cases				1
Chhotray et al. 2002	Orissa, India	1999	All ages	All-cause	Cyclone	Cases of diarrhea from government surveillance records	97,934 cases of diarrhea were recorded in the month following the cyclone vs. 551 during the same period in the previous year. Clustering of *V. cholerae* cases in the worst affected districts.	Of 107 stool samples, 79.5% positive for *V. cholerae*. Cyclone caused severe flooding in coastal areas up to 30km inland.	Surveillance records	97,934 diarrhea cases, 81 deaths				1

Supplemental Material, Table S3a (continued) – Flooding– studies with an explicitly defined comparison group

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size	Direction of Association			
											+	-	0	NA
Ding et al. 2013	Anhui Province, China	2007	All ages	All-cause	Flooding periods as defined by the categorization of the Chinese State Science and Technology Commission	Daily cases of diarrhea obtained from the National Notifiable Disease Surveillance System	Positive association between flooding days and incidence of diarrhea in both Fuyang (OR=3.18; 95% CI 1.13, 8.95) and Bozhou (OR=6.75; 95% CI 1.95, 23.34).	Different climate variables and lags were implemented for the final models in each of the villages.	Surveillance records	197 diarrhea cases	2			
Harris et al. 2008	Dhaka, Bangladesh	1998, 2004, 2007	All ages	Multiple	Flooding defined as the earliest and latest dates that any of the rivers around Dhaka exceeded flood stage	Diarrhea visits and pathogen-specific diarrhea at ICDDR,B	Diarrhea visits increased during the 2007 flood vs. non-flood months and were 2-3 times higher in flood years vs. non-flood years, although these differences were not evaluated statistically. *V. cholerae* was the most common cause of diarrhea during flood years. Rotavirus was a more common cause of diarrhea in non-flood years.	Data overlaps with Schwartz et al. 2006; also compared counts of pathogens between flood and pre-flood years.	Hospital surveillance	3,864 diarrhea cases				1
Hashizume et al. 2008 JWH	Dhaka, Bangladesh	1996 - 2001	All ages	Multiple	Flooding defined as the period that the Brigonga River exceeded the flood danger level	Cholera and non-cholera diarrhea cases presenting at ICDDR,B	Cholera and non-cholera diarrhea increased during floods and in post-flood periods. Observed to expected ratio for cholera during flood period 5.9 (95% CI: 5.0, 7.0); cholera during post-flood period: 2.1 (95% CI: 1.9, 2.4); non-cholera diarrhea during flood period 1.8 (95% CI: 1.6, 1.9); non-cholera diarrhea during post-flood period 1.2 (95% CI: 1.1, 1.3).	Higher risk of flood-related cholera and non-cholera diarrhea in lower hygiene and sanitation groups, and non-cholera diarrhea in lower SES groups, in the post-flood period. Controlled for seasonality and temperature. Compared flood and post-flood periods to the two preceding and subsequent years.	Hospital surveillance	772 cholera cases, 1,545 non-cholera diarrhea cases during flood period	4			

Supplemental Material, Table S3a (continued) – Flooding– studies with an explicitly defined comparison group

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size	Direction of Association			
											+	-	0	NA
Joshi et al. 2011	Uttar Pradesh, India	2009	< 5	All-cause	Flood exposed residents during the 2007 and 2008 floods	Self-reported diarrhea	The prevalence of diarrhea was 55.1% among the flood exposed group. No difference between flood-exposed and unexposed groups.	No test of association was performed between the flood exposed and unexposed groups. The survey of diarrhea prevalence was conducted the year following the exposure.	Community survey	807 survey respondents				1
Katsumata et al. 1998	Surabaya, Indonesia	1992-1993	All ages	Protozoan	Presence of flooding in rainy season	Laboratory-confirmed cases of cryptosporidiosis among study participants	Self-reported exposure to floods was associated with *Cryptosporidium* infection (OR = 3.08; 95% CI 1.94, 4.91).	Controlled for age, sex, season, contact with cats, rain, crowding, water treatment, public bathing, number of rooms in household, and living area. Also found higher prevalence of cryptosporidiosis during the rainy season in a hospital study.	Cross-sectional study	4,368 study participants	1			
Kondo et al. 2002	Gaza, Mozambique	2000	All ages	All-cause	Living in a flood-affected community	Patients presenting at a clinic or hospital with diarrhea	The incidence of diarrhea was 2-4 times greater at Hokwe Health Post and the number of patients in Chokwe District Hospital with diarrhea increased eight-fold compared to the same period in other years.	Largest flood in Mozambique in 50 years; 48 deaths and 800,000 evacuees.	Hospital and clinic records	339 diarrhea patients				1
Miettinen et al. 2001	Finland	1998 - 1999	All ages	All-cause	Floods and surface runoff	Waterborne disease outbreaks	The most common causes of waterborne disease outbreaks were floods and surface runoff.	Most outbreaks occurred in small groundwater systems.	Surveillance records	14 outbreaks; ~7,300 illnesses registered				1
Milojevic et al. 2012	Matlab, Bangladesh	2001-2007	All ages	All-cause	Self-reported flooding in the bari	Patients admitted to health care centers with diarrhea	No significant elevated risk among flooded vs. non-flooded residences during the flooding period following adjustment for pre-flood levels and season.	Multiple reported estimates for flooding during the post-flood period and for flooding in the absence of bari-level data.	Hospital surveillance and community surveys	211,000 residents			1	

Supplemental Material, Table S3a (continued) – Flooding– studies with an explicitly defined comparison group

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size	Direction of Association			
											+	-	0	NA
Mondal et al. 2001	Midnapur District, West Bengal, India	1998	All ages	All-cause	Flood prone homes	Self-reported diarrhea in household (2-week recall)	Significantly higher rates of diarrhea in flood-prone homes during flood period vs. pre-flood period and vs. control homes during flood period.	No modification of effect by water source, method of water storage, or hygiene practices.	Community survey	899 residents	2			
Reacher et al. 2004	Lewes, England	2000	All ages	All-cause	Flooding in home	Self-reported gastroenteritis	Positive but not significant association between flooding and gastroenteritis: RR=1.7 (95% CI: 0.9, 3.0). Significant increase in gastroenteritis by flood depth (test for trend p= 0.04).	Phone surveys of flooding victims conducted 9 months after the flood date.	Community survey	467 residents in 207 households	1		1	
Schnitzler et al. 2007	Germany	2002	$\geq$ 18	All-cause	Dermal contact with floodwater and flooding in the home	Self-reported diarrhea	Dermal contact with floodwater was significantly associated with diarrhea (OR: 4.6; 95% CI: 1.1, 19.5), but flooding inside the home was not (OR: 1.2; 95% CI: 0.6, 2.6).	91% of respondents' homes flooded. 78% had contact with floodwaters.	Community survey	477 survey respondents	1		1	
Schwartz et al. 2006	Dhaka, Bangladesh	1988, 1998, 2004	All ages	All-cause	Flooding, defined by the earliest and latest dates that any of the rivers reached or dropped below pre-determined flood stage, respectively	Flood-related diarrheal epidemics defined as periods when diarrhea visits exceeded the 90th percentile of the prior and subsequent year average	The average number of diarrhea cases per day more than doubled during flood-related epidemic periods (p<0.001). *V. cholerae* played a primary role in flood-related diarrheal epidemics, but other pathogens, particularly ETEC and rotavirus, also contributed.	Data overlaps with Harris et al. 2008. Individuals presenting during flood periods were older, more severely dehydrated, and of lower SES. Authors present data stratified by pathogen.	Hospital surveillance	2,229 patients during flood-related periods	1			
Setzer and Domino 2004	North Carolina, USA	1998 - 2000	All ages	Multiple	Areas severely affected by Hurricane Floyd	Monthly Medicaid outpatient visits for *Cryptosporidium*, *Giardia*, and Adenovirus	A significant increase in outpatient visits for ill-defined intestinal infections and adenovirus was seen in severely affected counties compared to unaffected counties, but no difference for *Giardia* or *Cryptosporidium*.	Study focused on counties with high concentrations of hog farming.	Health insurance records	52,592 outpatient visits	2		2	

Supplemental Material, Table S3a (continued) – Flooding– studies with an explicitly defined comparison group

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size	Direction of Association			
											+	-	0	NA
Siddique et al. 1989	Sandwip, Bangladesh	1985	All ages	All-cause	Flooding caused by a cyclone-associated tidal surge	Patient with diarrhea at any clinic or reported by field health workers	Cholera outbreak occurred 1 week after cyclone and tidal surge. Dominant agent of the outbreak was El Tor biotype of *V. cholerae* 01.	In the 4 weeks preceding the cyclone, 256 cases of diarrhea were reported. In the 2 weeks after the cyclone, 2,767 cases of diarrhea were reported.	Outbreak investigation	12,194 diarrhea cases; 51 deaths				1
Sur et al. 2000	West Bengal, India	1998	All ages	Bacterial	Flooding of two rivers	Diarrhea	Elevated number of cases observed following the flooding event compared to the same time period in previous two years. 72% of 29 rectal swabs positive for *V. cholerae.*	Cholera outbreak occurred after a severe flood. Outbreak began once floodwaters started to recede.	Outbreak investigation	16,590 cases; 276 deaths				1
Vollaard et al. 2004	Jakarta, Indonesia	2001 - 2003	All ages	Bacterial	Inundation of the participant's household within preceding 12 months	Laboratory-confirmed *S. typhi* infection	Exposure to flooding was more common in cases than community controls in multivariate analysis: *S. typhi*: OR=1.65 (95% CI 0.88, 3.08); *S. paratyphi*: OR=4.52 (95% CI 1.90, 10.73).	Controlled for handwashing with soap, sharing food, toilet in home, recent typhoid case in home, age, eating food from street vendors, use of ice, and crowding.	Case-control study	93 cases, 378 community controls	1		1	
Wade et al. 2004	Mississippi River Basin, USA	2001	All ages	All-cause	Period during which Mississippi River was above the 15-foot flood stage and 1 week after flood recession below this stage	Self-reported Highly Credible Gastrointestinal Illness (HCGI)	Increased incidence of HCGI during flood period vs. non-flood period (IRR=1.29; 95%CI 1.06, 1.58). Similar but weaker association of diarrhea (IRR=1.23; 95% CI 0.94, 1.62).	Flooding in the house or yard, but no other specific exposures, was significantly associated with increased gastrointestinal illness.	Cohort study	1,110 cohort subjects	1			
Waring et al. 2005	Houston, Texas, USA	2001	All ages	All-cause	Self-reported flooding in the home	Self-reported diarrhea	More diarrhea reported in flooded households than non-flooded households (OR=10.8; 95% CI 1.5, 8.3).	Confidence interval is inconsistent with the estimate, though both table and text describe the association as significant.	Community survey	420 households				1

Supplemental Material, Table S3a (continued) – Flooding– studies with an explicitly defined comparison group

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size	Direction of Association			
											+	-	0	NA
Woodruff et al. 1990	Khartoum, Sudan	1988	All ages	All-cause	Flooding caused by heavy rainfall	People with diarrhea reporting to sentinel surveillance facilities	Diarrhea cases increased compared to pre-flood period and same time period the previous year. Diarrheal disease accounted for the greatest number of clinic visits.		Hospital and clinic records	10,142 diarrhea cases				1

Supplemental Material, Table S3b: Articles included in the systematic review of the relationship between flooding and diarrheal diseases—outbreak reports.

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size
Ahmed et al. 1991	Bangladesh	1988 - 1989	All ages	Viral	Widespread flooding as a consequence of heavy monsoon rains	Hospital patients with laboratory-confirmed rotavirus	Increase in diarrhea cases, proportion of rotavirus diarrhea, rotavirus in older children, percentage of mixed rotavirus infection cases, and an abrupt change in epidemic strains coincided with the spread of the flood.	Unusually heavy monsoon led to widespread flooding. Increased cases coincided with flooding, not rainfall.	Hospital study	298 rotavirus cases
Ahmed et al. 2011	Rajanpur District, Pakistan	2010	All ages	All-cause	Flood-affected areas	Diarrhea cases	30% of clinical visits for infectious disease were for diarrhea.	Interviewed flood victims at relief camp clinic.	Relief camp survey	7,814 flood affected persons
Bhunia and Ghosh 2011	West Bengal, India	2009	All ages; > 5	All-cause	Cyclone Aila; Drinking non-chlorinated piped water	Hospital admissions for acute watery diarrhea and severe dehydration	Following the Cyclone 1,076 cases were admitted; Drinking from the unchlorinated, piped water supply was significantly associated with acute, watery diarrhea admission.	The piped water supply for Gosaba block was broken during the cyclone and contaminated by subsequent flooding. Coliforms were detected in the water supply.	Outbreak investigation	1,076 cases
Bingnan et al. 1991	Matlab, Bangladesh	1987 - 1989	All ages	Viral	Major flooding	Hospital patients with laboratory-confirmed rotavirus	A peak in the proportion of stools positive for rotavirus coincided with a major flood.	Rotavirus diarrhea declined immediately after the flood, whereas diarrhea attributable to other causes remained high.	Hospital surveillance	5,811 diarrhea cases, 898 with rotavirus
CDC 2005a	Louisiana, Mississippi, Tennessee, and Texas, USA	2005	All ages	Multiple	Hurricane Katrina evacuees	Diarrhea reported at evacuation centers	Diarrhea clusters reported in evacuation camps in multiple states. Pathogens detected included norovirus and *Salmonella*.	Three weeks after the initial displacement caused by Katrina, few diarrhea cases reported.	Outbreak investigation	Not stated
CDC 2005b	Texas, USA	2005	All ages	Viral	Hurricane Katrina evacuees	Patients visiting relief clinics with AGI	18% of visits to relief clinics were for AGI. Norovirus was confirmed in 50% of the 44 specimens tested.		Outbreak investigation	1,169 AGI cases
CDC 2005c	Louisiana, USA	2005	All ages	All-cause	Persons living in and around 4 parishes in New Orleans	Diarrhea	3.5% of hospital and clinic visits were for diarrhea.	Cases detected by an active surveillance system that included hospital and clinics.	Surveillance report	146 diarrhea cases
CDC 2012	Pakistan	2010	All ages	All-cause	Severe flooding	Diarrhea reports to the Disease Early Warning System (DEWS)	13.3% of disease reports to DEWS were for diarrhea. 88.5% of outbreaks were for acute watery diarrhea (AWD) (suspected cholera).		Surveillance report	745,532 diarrhea cases; 115 AWD outbreaks

Supplemental Material, Table S3b (continued) – Flooding– outbreak reports

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size
Kukkula et al. 1997	Noormarkku, Finland	1994	All ages	Viral	Spring flooding caused by abnormal winter snowfall	Gastroenteritis	Record high spring flooding caused backflow to a groundwater well, contaminating the municipal water supply. Microbiological testing implicated Norwalk virus as the main cause of the outbreak.	25-50% of the population had symptomatic acute gastroenteritis.	Outbreak investigation	~2,500 cases
Kunii et al. 2002	Bangladesh	1998	All ages	All-cause	Residence in flood-affected district	Self-reported diarrhea	26.6% of individuals reported diarrhea (new or exacerbated) during the flood.	The 1998 flood affected over 30 million people, and was longer and more extreme than most in recent history in Bangladesh.	Community survey	517 survey respondents
Paul et al. 2011	Bangladesh	2008	All ages	All-cause	Exposure to flooding resulting from Cyclone Sidr	Self-reported diarrhea in the 3-month period following the cyclone	Post-cyclone incidence of water-borne and other diseases was not unusually high. Diarrhea rate: 1.4%.	A major outbreak of diseases may have been avoided because of the proper distribution of food and safe drinking water, and timely implementation of health care intervention measures.	Community survey	277 households surveyed; 1,443 individuals
Qadri et al. 2005	Dhaka, Bangladesh	2004	All ages	Bacterial	Extreme flooding	Patients with diarrhea presenting to ICDDR,B	Diarrhea epidemic occurred following extreme floods. Suspect floodwater contaminated with sewage may have led to ETEC spread.	22% of 350 stool samples tested were positive for *V. cholerae* 01 and 18% were positive for ETEC.	Outbreak investigation	> 17,000 diarrhea cases
Schmid et al. 2005	Salzburg, Austria	2005	All ages	Viral	Exposure to floodwaters	Diarrhea or vomiting	Results of the investigation indicated that exposure to sewage contaminated floodwaters inside a hotel resulted in a norovirus outbreak among the group.		Outbreak investigation	49 cases
Siddique et al. 1991	Sandwip, Bangladesh	1988	All ages	All-cause	Major flooding	Diarrhea and watery diarrhea at relief clinics	Diarrhea was the most common illness seen at post-flood relief clinics (34.7% of patients). Watery diarrhea was the most common type of diarrhea (47%) and the most common cause of death for all age groups < 45 years old.		Relief clinic records	46,740 patient visits
World Health Organization 2005	Aceh Province, Indonesia	2004 - 2005	All ages	All-cause	Flooding caused by large tsunami	Diarrhea cases	24.7% of relief clinic patients were seen for acute watery diarrhea or bloody diarrhea. 11 bloody diarrhea and 1 acute watery diarrhea outbreaks reported.		Surveillance report	10,059 diarrhea cases

Supplemental Material, Table S4: Articles included in the systematic review of the relationship between drought and diarrheal diseases. Direction of association columns indicate the number of analyses presented by the authors of the article that resulted in a positive ("+"), negative ("-"), or neutral ("0") association between exposure of interest and outcome, based on statistical analysis. Positive or negative relationships were defined as $p<0.05$ or 95% CI did not include the null. "NA" indicates article did not present results of a statistical analysis.

Reference	Location	Period	Ages	Pathogen	Exposure Definition	Outcome Definition	Results/ Conclusion	Comments	Data Source	Study Size	Direction of Association			
											+	-	0	NA
Burr et al. 1978	Wales, UK	1978	< 18	All-cause	Drought-induced water restrictions	Weekly counts of diarrhea or vomiting	Positive dose response relationship between hours of daily water restrictions and counts of diarrhea and vomiting.	Diarrhea reporting completed by head teachers. Restrictions lifted in 2nd week of data collection.	Community Survey	55,000 students in 291 schools	1			
de Sherbinin 2011	Africa	1992 - 2002	< 18	All-cause	Number of droughts occurring 1980-2000, defined as precipitation < 75% of the median for ≥ 3 months	Proportion of children with diarrhea in the 2 weeks preceding the interview	No significant correlation between diarrhea and drought.	Diarrhea was not the primary dependent variable for analysis.	Secondary data analysis of community surveys	NA			1	
Effler et al. 2001	Swaziland	1992 - 1993	> 5	Bacterial	Severe drought for 3 months and subsequent heavy rainfall	*E. coli* O157:NM and cholera	Outbreak of *E. coli* began 3 days after onset of rains. Authors speculate contamination of scarce water sources by livestock led to outbreak.	Outbreak accompanied by a seven-fold increase in cattle deaths.	Outbreak Investigation	>2,868 diarrhea cases				1

Table S5. Summary of quantitative associations between diarrhea and drought, flooding, heavy rainfall and temperature reported in 67 articles with quantitative estimates.

	Papers	Analyses	Positive	Negative	Neutral
Temperature	45	82	53 (65%)	16 (20%)	13 (16%)
All-cause	11	16	11 (69%)	3 (19%)	2 (13%)
Bacterial	21	47	37 (79%)	3 (6%)	7 (15%)
Protozoan	3	5	3 (60%)	0 (0%)	2 (40%)
Viral	10	14	2 (14%)	10 (71%)	2 (14%)
Flooding	14	25	19 (76%)	0 (0%)	6 (24%)
All-cause	12	17	14 (82%)	0 (0%)	3 (18%)
Bacterial	2	4	3 (75%)	0 (0%)	1 (25%)
Protozoan	2	3	1 (33%)	0 (0%)	2 (67%)
Viral	1	1	1 (100%)	0 (0%)	0 (0%)
Heavy rainfall	10	14	10 (71%)	3 (21%)	1 (7%)
All-cause	8	11	8 (73%)	2 (18%)	1 (9%)
Bacterial	2	3	2 (67%)	1 (33%)	0 (0%)
Protozoan	0	--	--	--	--
Viral	0	--	--	--	--
Drought	2	2	1 (50%)	0 (0%)	1 (50%)
All-cause	2	2	1 (50%)	0 (0%)	1 (50%)
Bacterial	0	--	--	--	--
Protozoan	0	--	--	--	--
Viral	0	--	--	--	--

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Protozoan	0	--	--	--	--
Viral	0	--	--	--	--
Drought	2	2	1 (50%)	0 (0%)	1 (50%)
All-cause	2	2	1 (50%)	0 (0%)	1 (50%)
Bacterial	0	--	--	--	--
Protozoan	0	--	--	--	--
Viral	0	--	--	--	--