Effects of Climate Change Shocks and Sensitivities on Mental Health Outcomes in Ghana

Departmental Lecture

University of Bristol

14th March 2023

Outline of Presentation

- Introduction
  - Research Questions
- Data and Methods
- Results
  - Descriptive (sub-group)
  - Spatial
  - Regression analyses
- Concluding remarks
  - Summary of findings

INTRODUCTION

Introduction

- Climate change research focused mostly on economic and environmental impacts
- Health impacts comprise mostly *physical* effects
  - respiratory and cardiovascular disease, injuries, food- and water-borne illnesses, and other infectious diseases, as well as premature deaths (Trtanj et al., 2016; Lawrance et al., 2021).
- Some of the most important health consequences of climate change will be particularly on mental health (Page and Howard, 2010; IPCC, 2022)
  - Witnessing events and develop PTSD (Galea et al., 2005); depression (Marshall et al., 2007), or substance use disorders (Myers et al., 2011).
  - Climate events can lead to unemployment, homelessness/ forced migration, and food insecurity
  - Higher temperatures may worsen individuals' moods and lead to increased stress (Burke, et al., 2018; Liu et al., 2021)
  - Damage to health and other infrastructure following from climate change events

Introduction

- Research on climate change and mental health conducted mostly in Europe, North America, and Australia
  - Several of the areas that are currently most vulnerable to climate change are in low- and middle-income settings, with few adaptive mechanisms.

Introduction- Ghana

- Average annual temperature of 28°C, the number of hot days and nights have increased by about 13% and 20%, respectively, from the 1960s (World Bank, 2021)
- Rainfall patterns have become increasingly irregular in Ghana, triggering floods, droughts, and heatwaves, with implications for health and production activities
  - More variable weather is expected into the future
- Research on depression and mental health rarely focuses on climate change shocks
  - Maternal depression (Weobong, 2012; Saeed and Wemakor, 2019); depression among graduate students (Asante and Adoh-Arthur, 2015); depression among health care providers (Opoku Agyemang et al., 2022).

Introduction- Ghana

- Exceptions- Acharibasam and Anuga (2018); Dziwonu and Kugbey (2015)
  - Not nationally representative (scarcity of national data on climate shocks)
  - Not empirically robust
  - Cross sectional data- no corrections for unobserved time-invariant individual- level factors

Introduction- Research Questions

1. What is the spatial distribution of climate shocks and sensitivities in Ghana?
    a. Where are the climate sensitivity hot/cold spots?
2. What is the prevalence of depression among different subgroups
    a. Gender, rural/urban residence, poverty, age groups (adolescents, adults, and elderly).
3. What are the effects of climate shocks and sensitivities on mental health outcomes?
    a. Do effect vary among different subgroups of the population?
    b. Are effects mediated by personality traits of individuals?

DATA AND MEASUREMENT OF MAIN STUDY VARIABLES

(OUTCOME, EXPLANATORY, MEDIATING)

Data

- 3 waves of the nationally representative Ghana Socioeconomic Panel Survey (2009-2019)
  - 5,010 households and 18,889 individuals in Wave 1
  - 4,774 households and 16,356 individuals in Wave 2
  - 5,669 households and 19,006 individuals in Wave 3
- The Geocoded Disasters (GDIS) dataset from Emergency Events Database (EM-DAT)
  - GIS information (longitudes and latitudes) on the location of disasters
- Merge districts in GDIS with districts in the GSEPS dataset

Data- Measurement of Main Study Variables: Depression (Outcome Variable)

- Kessler Psychological Distress (K10) scale
- 10 questions asked on individual's emotional state
  - Head, first spouse, random member 12^{+} years
- Scores are summed up from the 5-level responses and range from 10 (minimum) to 50 (maximum)
- Higher scores indicate greater psychological distress.
- Useful in both developed (Furukawa et al., 2003; Arnaud et al., 2010), and developing country contexts (Chan and Fung, 2014; Owoo & Lambon-Quayefio, 2021).

	About how often do you feel:	***Response options and coding:***
1.	Tired out for no good reason?	1. None of the time- 1
2.	Nervous?	2. A little of the time- 2
3.	So nervous that nothing could calm you down?	3. Some of the time- 3
4.	Hopeless?	4.Most of the time- 4
5.	Restless or fidgety?	5. All of the time- 5
6.	So restless you could not sit still?	
7.	Depressed?	
8.	Everything is an effort?	
9.	So sad that nothing could cheer you up?	
10.	Worthless?	

Data- Measurement of Main Study Variables: Climate Change Sensitivity (Main explanatory variable 1)

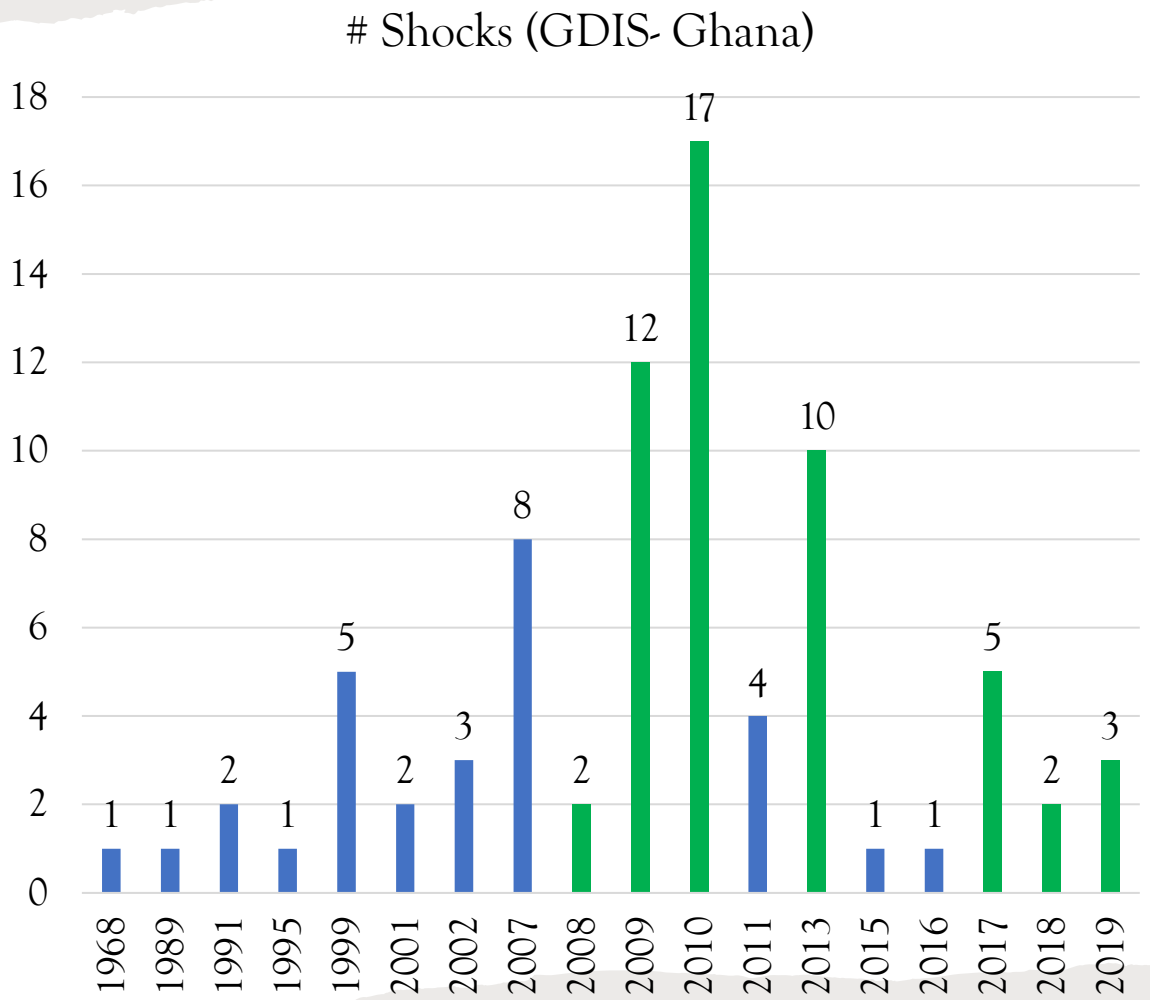
Dimension	Indicator (11)	Rationale for sensitivity
Demographic	Children under 10 years	Babies and lower resistance to heat stress. Young children relatively short, light, and may not be strong enough swimmers (Mort et al., 2016).
	Elderly members 60+	More sensitive to heatwaves esp. if pre-existing conditions (Kenny et al., 2010)
	Pregnant women	Higher risk of spontaneous abortion, low birthweight, neonatal deaths, congenital anomalies, and maternal mortality due to flooding (Mallett and Etzel, 2017)
	Disabled members	Greater risk of harm during extreme climate events (Gutnik and Roth, 2018).
Economic	Outdoor occupations	Exposed to increases in temperature, poor air quality, and extreme weather
Housing	Construction materials	Natural materials like mud/earth for floor, walls and roofs
	Water	Surface water increases vulnerability to flood and drought
	Sanitation	Open defacation/unimproved sanitation leads to sewage contamination
	Information	TV/Radio/internet increases access to disaster warnings and information
Nutrition	Stunting	Poorer health and weaker response to extreme events
	Food security	Poor health from poor nutrition suggests poor coping and resistance to shocks

Data- Measurement of Main Study Variables: Climate Change Sensitivity (Main explanatory variable 1)

- Index developed as weighted sum of sensitivity scores from eleven (11) indicators
- $Average\ Sensitivity\ index_h = \frac{1}{n}\sum_{i=1}^{n} Indicator_i$
- The constructed index takes a value between 0 and 1 with higher scores indicative of greater household sensitivity to climate change
  - Average sensitivity scores were also constructed for each sub-set of the four (4) categories of indicators (i.e., demography, economic, housing and nutrition)

Data- Measurement of Main Study Variables: Climate Change Shocks (Main explanatory variable 2)

- Number of events that occurred the year before and during years of data collection.
  - For Wave 1 (collected in 2009/10), climate shocks data for 2008, 2009 and 2010 were used.
  - There were no climate shocks data available for 2012 and 2014 i.e., the years before and during collection of Wave 2 in 2013/14. Therefore, only data for 2013 was used.
  - For Wave 3 (collected in 2018/19) climate shocks data for 2017, 2018 and 2019 were used.



Data- Measurement of Main Study Variables: Personality Traits (mediating variable)

- Big 5 Personality Traits
- A series of 44 questions were posed to the household head, the first spouse and another random household member above 12 years of age.
- Based on responses, individuals were given scores on five (5) major personality traits

Big Five Dimensions	Facet (and correlated trait adjective)
Extraversion vs. introversion	Gregariousness (sociable) Assertiveness (forceful) Activity (energetic) Excitement-seeking (adventurous) Positive emotions (enthusiastic) Warmth (outgoing)
Agreeableness vs. antagonism	Trust (forgiving) Straightforwardness (not demanding) Altruism (warm) Compliance (not stubborn) Modesty (not show-off) Tender-mindedness (sympathetic)
Conscientiousness vs. lack of direction	Competence (efficient) Order (organized) Dutifulness (not careless) Achievement striving (thorough) Self-discipline (not lazy) Deliberation (not impulsive)
Neuroticism vs. emotional stability	Anxiety (tense) Angry hostility (irritable) Depression (not contented) Self-consciousness (shy) Impulsiveness (moody) Vulnerability (not self-confident)
Openness vs. closedness to experience	Ideas (curious) Fantasy (imaginative) Aesthetics (artistic) Actions (wide interests) Feelings (excitable) Values (unconventional)

Data: (Main and Mediating Variables)

	2009		2014		2019	
	Mean	SD	Mean	SD	Mean	SD
Main variables						
Depression scores	15.71	4.94	15.47	5.05	16.45	5.76
Average sensitivity Scores	0.30	0.18	0.29	0.17	0.28	0.17
Demography	0.23	0.15	0.21	0.16	0.19	0.17
Economic	0.57	0.5	0.61	0.49	0.59	0.49
Housing	0.34	0.3	0.31	0.28	0.29	0.28
Nutrition	0.21	0.36	0.25	0.31	0.27	0.32
# Climate shocks	0.80	0.81	0.02	0.13	0.14	0.35
Mediating Variables						
Personality trait - Extraversion	3.44	0.7	3.46	0.71	3.41	0.7
Personality trait - Agreeableness	4.44	0.59	4.45	0.58	4.45	0.57
Personality trait - Conscientiousness	4.45	0.65	4.46	0.62	4.44	0.63
Personality trait - Neuroticm	2.09	0.7	2.09	0.7	2.17	0.7
Personality trait - Openness	3.49	0.6	3.47	0.62	3.43	0.63

Data: Other Control Variables

	2009		2014		2019	
Domestic work (hours)	5.75	4.24	4.45	4.21	6.31	4.29
Male	0.5	0.5	0.48	0.5	0.49	0.5
Poor	0.26	0.44	0.23	0.42	0.27	0.45
Age (years)	32.83	14.1	33.23	14.77	33.53	15.21
Married	0.56	0.5	0.48	0.5	0.44	0.5
Widowed/Separated/Divorced	0.07	0.26	0.09	0.29	0.11	0.31
Never married	0.37	0.48	0.43	0.5	0.46	0.5
No education	0.004	0.07	0.02	0.12	0.01	0.08
Primary education	0.22	0.41	0.23	0.42	0.22	0.41
Secondary education plus	0.77	0.42	0.76	0.43	0.78	0.42
Urban	0.59	0.49	0.62	0.49	0.64	0.48
Household size	4.95	2.17	4.39	2.07	3.74	2.04
Currently working in paid employment	0.19	0.4	0.16	0.37	0.15	0.35
Christian	0.91	0.29	0.91	0.28	0.89	0.31
Muslim	0.09	0.29	0.09	0.28	0.11	0.31
Akan	0.59	0.49	0.57	0.5	0.57	0.5
Ga	0.12	0.33	0.14	0.34	0.13	0.34
Ewe	0.13	0.33	0.14	0.35	0.13	0.34
Northern ethnicity	0.16	0.37	0.15	0.36	0.17	0.38
Western Region	0.13	0.33	0.11	0.32	0.1	0.3
Central Region	0.11	0.31	0.11	0.31	0.11	0.31
Greater Accra Region	0.22	0.41	0.2	0.4	0.2	0.4
Volta Region	0.07	0.26	0.08	0.28	0.07	0.26
Eastern Region	0.11	0.31	0.13	0.34	0.11	0.31
Ashanti Region	0.2	0.4	0.2	0.4	0.22	0.41
Brong Ahafo Region	0.09	0.29	0.09	0.29	0.09	0.29
Northern Region	0.03	0.17	0.03	0.18	0.05	0.23
Upper East Region	0.03	0.16	0.03	0.16	0.03	0.17
Upper West Region	0.02	0.13	0.02	0.12	0.01	0.11
Observations (14,243)	4747		4830		4666	

METHODS

Methods: Spatial, Descriptive and Regression Analyses

- Spatial analyses
  - Spatial mapping of the distribution of sensitivities and shocks
  - Hot Spot analyses of climate change sensitivities (2009- 2019)
- Descriptive analyses
  - Subgroup analyses of depression in Ghana (gender, residence, poverty, age groups) over time

Methods: Spatial, Descriptive and Regression Analyses

- Regressions
  - Fixed effects Poisson regression model specifications

$$Depression_{i,t} = \alpha_1 + \alpha_2 Sensitivity_{i,t} + \alpha_3 X_{i,t} + \epsilon_{i,t} \quad (1)$$

$$Depression_{i,t} = \beta_1 + \beta_2 Shocks_{i,t} + \beta_3 X_{i,t} + \epsilon_{i,t} \quad (2)$$

$$Depression_{i,t} = \delta_1 + \delta_2 Sensitivity_{i,t} + \delta_3 Shocks_{i,t} + \delta_4 X_{i,t} + \epsilon_{i,t} \quad (3)$$

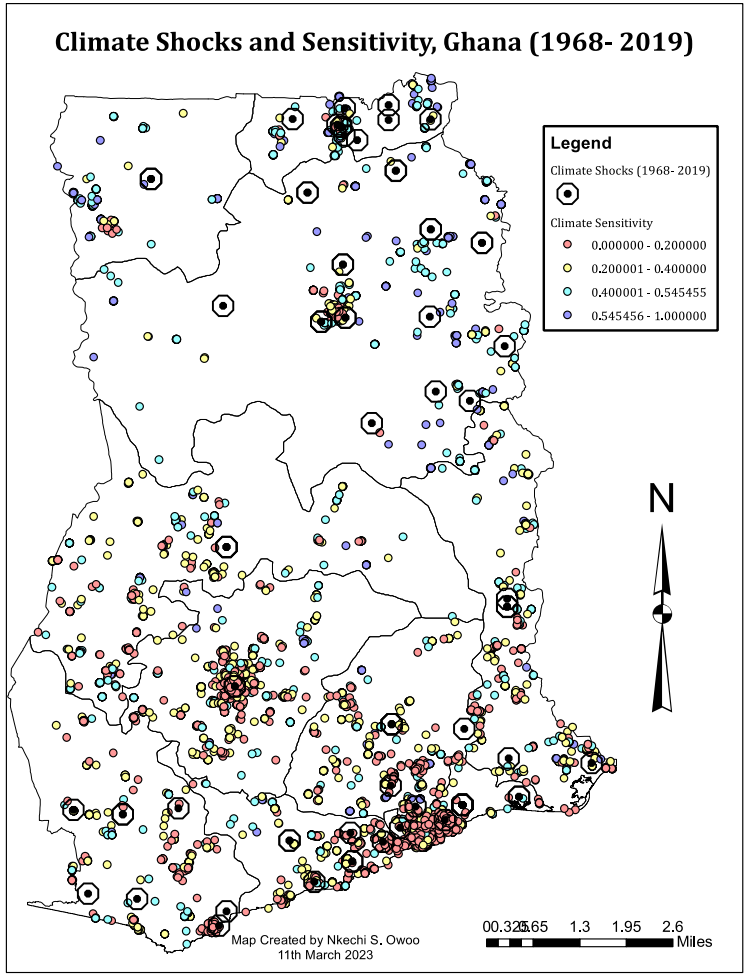
$$Depression_{i,t} = \lambda_1 + \lambda_2 Shocks_{i,t} + \lambda_{3-6} SensitivityGroups_{1-4} + \lambda_5 X_{i,t} + \epsilon_{i,t} \quad (4)$$

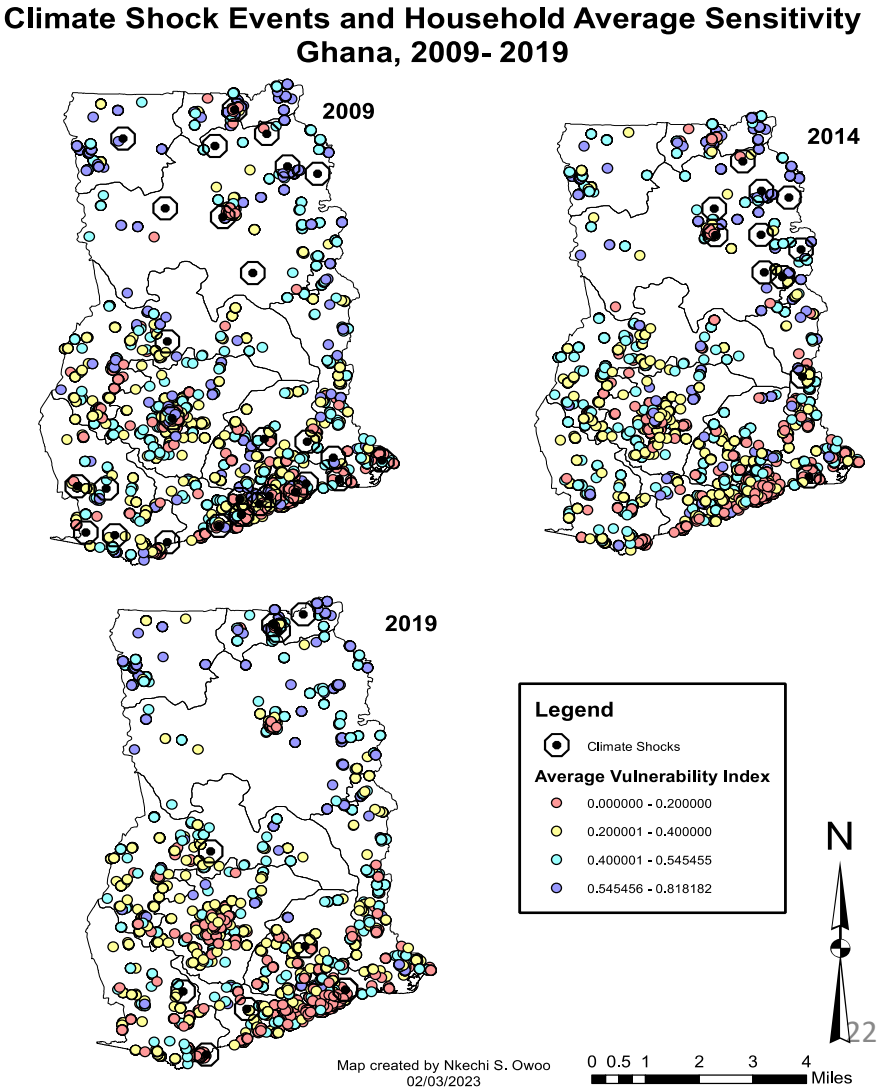
    - Regressions by different subgroups (men vs women; rural vs urban; poor vs. non poor; adolescents, adults and elderly)
    - Mediating effects of personality traits
  - Robustness- Quantile regression modelling

PRELIMINARY RESULTS

SPATIAL, DESCRIPTIVE AND REGRESSION ANALYSES

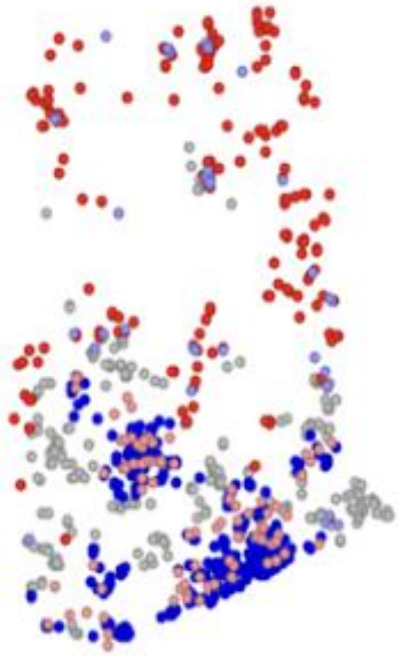
Results: Spatial Analyses
Distribution of Shocks and Sensitivities across Ghana

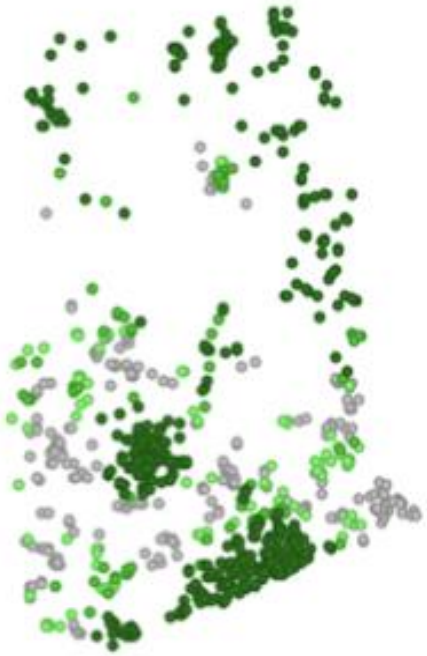


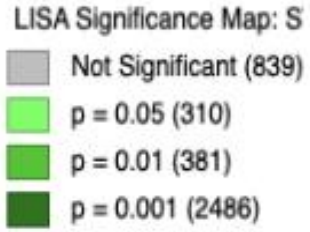


Results: Spatial Analyses
Hot Spot Analyses

2019 (Moran's Index= 0.395)

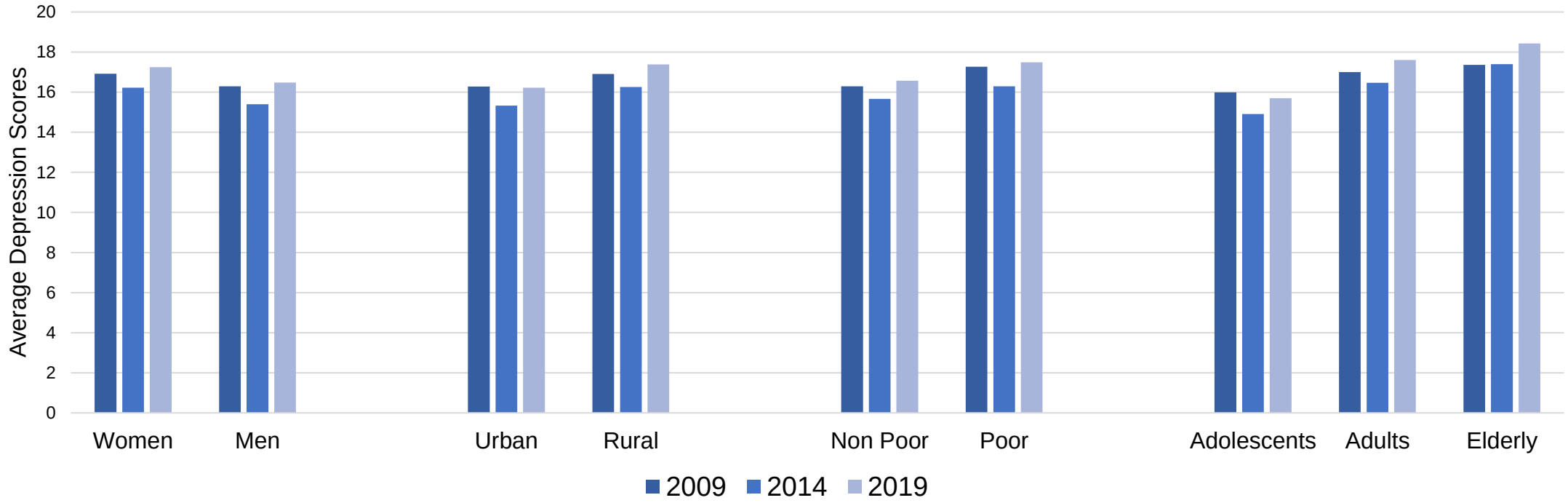






Similar spatial correlation patterns (and significance) observed in all waves of data

Results: SubGroup Decomposition of Mental Health Outcomes



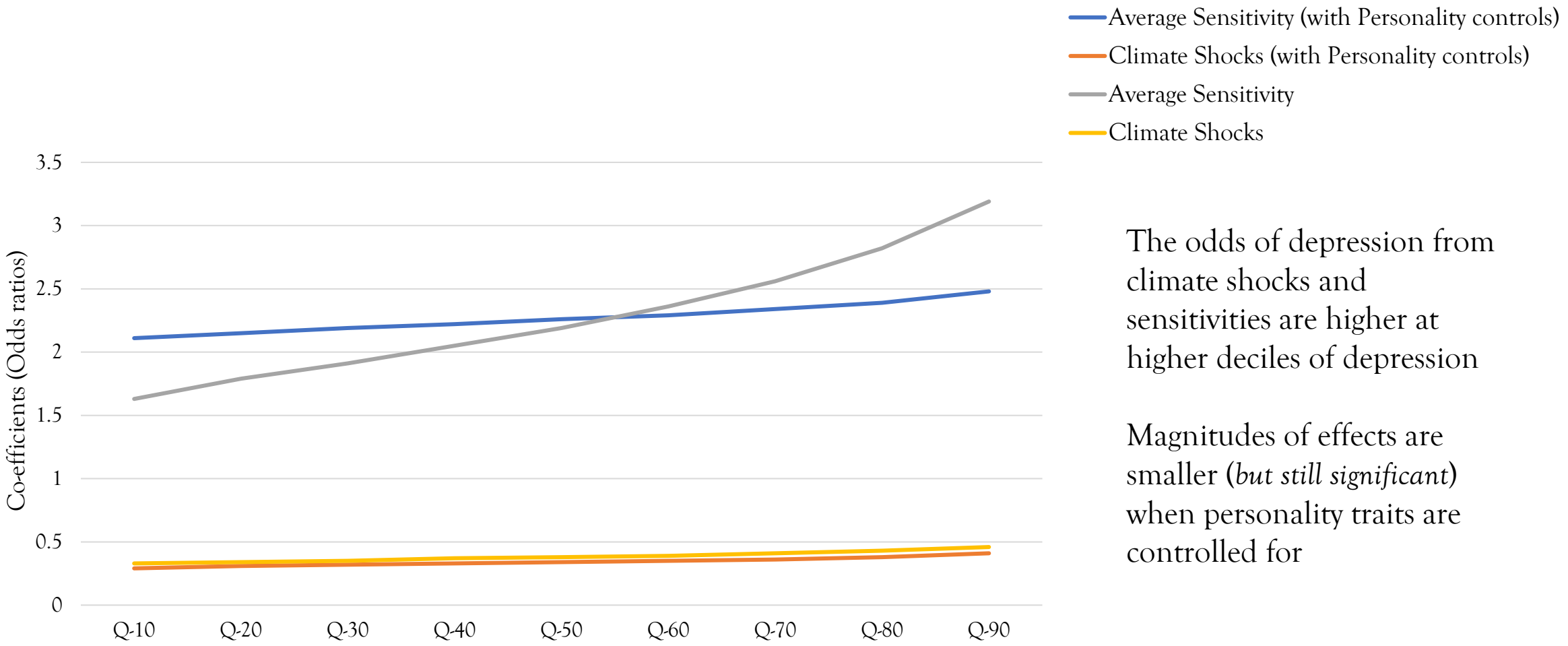
- Depression decreases in 2014, from 2009 levels, but increases by 2019
- Mental health is poorer among women, rural dwellers, poor households and among adults and the elderly

Results: Fixed Effects Poisson Regressions

	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	Without Personality trait controls				With Personality trait controls			
Average climate vulnerability	1.093***	-	1.090***	-	1.070*	-	1.068*	-
	(2.86)	-	(2.79)	-	(1.93)	-	(1.86)	-
Climate shock	-	1.033**	1.033*	1.032*	-	1.026	1.025	1.025
	-	(1.98)	(1.94)	(1.93)	-	(1.53)	(1.49)	(1.49)
Demographic vulnerability	-	-	-	1.076***	-	-	-	1.060**
	-	-	-	(2.94)	-	-	-	(1.99)
Economic vulnerability	-	-	-	1.018**	-	-	-	1.018**
	-	-	-	(2.28)	-	-	-	(2.06)
Housing vulnerability	-	-	-	1.035*	-	-	-	1.020
	-	-	-	(1.72)	-	-	-	(0.89)
Nutrition vulnerability	-	-	-	0.992	-	-	-	0.999
	-	-	-	(-0.69)	-	-	-	(-0.09)
All controls	YES	YES	YES	YES	YES	YES	YES	YES
# Observations	14243	14243	14243	14235	10643	10643	10643	10638

t statistics in parentheses: * p<0.10, ** p<0.05, *** p<0.01; Robust errors at district level; Odds ratios reported.

Results: Fixed Effects Quantile Regressions [Specifications (1) and (2)]



*Coefficients all significant at at least 5% level; All controls included

The odds of depression from climate shocks and sensitivities are higher at higher deciles of depression

Magnitudes of effects are smaller (*but still significant*) when personality traits are controlled for

Results: Fixed Effects Poisson Regressions Heterogenous Effects

- Gender
  - Women and men have higher odds of depression with climate sensitivity and shocks
  - Effects removed after controlling for personality; except for men.
    - Higher odds of depression with increased demographic and economic sensitivities
- Household poverty
  - No significant odds of depression with climate change shocks and sensitivities among the poor
  - Among non-poor, higher odds of depression with both shocks and sensitivity
    - Controlling for personality, still higher odds of depression with increased demographic and economic sensitivities
- Rural/Urban residence
  - Higher odds of depression with more shocks in rural areas; with increased sensitivity (economic and housing) in urban areas
  - Effects minimised but still significant after controlling for personality traits
- Age groups
  - No significant effects for the young and elderly
  - Adults show higher odds of depression with more shocks and increased sensitivity (economic) although magnitudes of effects reduce with controls for personality traits

Summary of Findings

- Climate change has important mental health effects; area largely understudied, especially in developing country settings
- Climate shocks (mostly flooding) occur all over the country, particularly along the coast and the Volta lake and northern parts of the country
- Climate change sensitivities are higher in the northern, compared to southern regions
  - Combined with climate shocks, burden/effects of shocks greater for people in the northern region
- Poor mental health prevalent among women, poor and rural households, and among elders
- Higher odds of depression with greater climate shocks and increased sensitivities, controlling for host of variables
  - However, this is largely due to personal traits like neuroticm which increases predisposition to environmental stresses

Thank you for your attention!

Your questions/comments are welcome.

Nkechi S. Owoo

nkechi.owoo@gmail.com