WaTCH

Women and Their Children's Health Study

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EPIDEMIOLOGY

UNMC COLLEGE OF PUBLIC HEALTH

The Deepwater Horizon Oil Spill and Health in Louisiana Women

THE PAST, PRESENT, & FUTURE

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British Petroleum Deepwater Horizon drilling rig exploded off the coast of Louisiana on April 20, 2010

200 million gallons of crude oil spilled into the Gulf of Mexico over the next 3 months

11 platform workers were killed, and 17 others were injured.

Deepwater Horizon Oil Spill

Health Effects from Oil Spills

- Limited long-term studies of health effects
- Prior studies of oil spill exposure show:
  - It leads to direct and indirect physical, social, and economic changes in the environment
  - May lead to mental and physical health consequences
- Southern Louisiana particularly vulnerable to disasters
  - Hurricanes, economy, oil
- Challenges for rapid response to disasters and research
  - No baseline data
  - Funding mechanisms slow, lack of infrastructure

WaTCH Aims:

Women

- To study the long-term physical and mental health effects of women and their families exposed to the Deepwater Horizon oil spill event.

Children

- To understand the impacts of the Deepwater Horizon oil spill on children's development and well-being, and to examine how parental and social forces changes the spill's effects on children.

Methods - Sample

- Prospective cohort of women from 7 Southeastern parishes of LA
  - St. Mary, Terrebonne, Lafourche, Jefferson, Plaquemines, Orleans, & St. Bernard

- Random sample of ~2500 women and ~600 children using sampling frame of household telephone numbers
  - Inclusion criteria:
    - 18-80 years (women); 10-17 years (children)
    - Lived in one of seven target parishes on April 20, 2010
    - Did not participate in NIEHS GuLF Study

Peters ES, Rung AL, et al., The Women and Their Children's Health (WaTCH) Study: Methods and Design of a Prospective Cohort Study in Louisiana to Examine the Health Effects from the BP Oil Spill. BMJ Open 2017

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WaTCH Study

- First wave of data collection completed between July 2012 and June 2014
  - Telephone interviews with 2,852 women (18-80 yrs.)
    - Response rate = 43.3%
  - Home visits and blood samples on 1,281 of these women
  - Interviews with 622 children (10-17 yrs.)
- Wave 2 telephone follow-up completed 6/2016.
  - 2,038 women and 457children re-interviewed
    - Retention = 72%
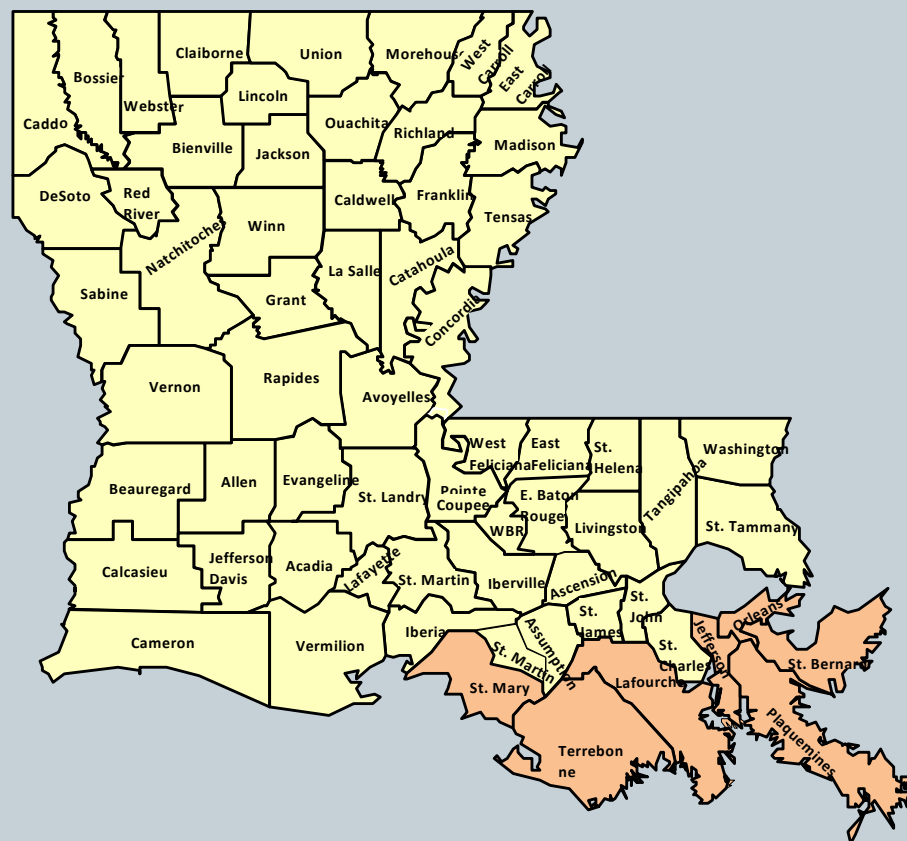
Exposure - Indirect Assessment

Item	Total	Economic	Environmental / Physical
Did you or anyone in your household lose any income due to disruption of employment or closing a business b/c of the oil spill?	X	X	
Compared to other residents in your community, were you hit harder by the oil spill than other, affected about the same, or affected less?	X	X	
How would you rate the influence of the oil spill on your household's current financial situation?	X	X	
Has the oil spill directly affected the recreational hunting, fishing, or other activities of any members of your household?	X		X
Did you work on any of the oil spill cleanup activities?	X		X
Are there any other ways that you came into physical contact with the oil from the spill or cleanup activities?	X		X
Has the oil spill directly affected the recreational hunting, fishing, or other activities of any members of your household?	X		X
Did you have any property that was lost or damaged because of the oil spill or cleanup?	X		X
How often could you smell the oil/How strong was the smell?	X		X

Outcomes

- Physical health
  - Self-report how often thirteen physical health symptoms occurred between April 20, 2010, and December 25, 2010, the eight-month time period immediately following the DHOS.

- Mental Health
  - Self-report at the time of the interview using validated instruments on depression and mental distress (CES-D & K-6)
  - Self Report on PTSD using PCL-5

Women Demographic Characteristics

Disposition	N	%
Hard Refusal	11349	25
Disconnected	8020	18
No Answer	12953	29
No eligible respondent	7756	17
Complete	**2,852**	6
Fax	1212	3
Business	384	1
Qualified Refusal	284	1
Busy/Language/Other	341	1
Total Sample	**45,151**	

Characteristic	N (%)
Total	**2852 (100)**
Race/ethnicity	
White, NH	1562 (56.5)
African American, NH	956 (34.6)
Other	245 (8.9)
Age, years (mean, SD)	**45.7 (12.0)**
18-36	647 (22.7)
37-44	700 (24.5)
45-50	791 (27.7)
51-80	714 (25.0)

Women Demographic Characteristics

Characteristic	N (%)
Education	
Less than high school	326 (11.8)
High School Grad	1639 (59.3)
College grad or beyond	800 (28.9)
Household Income	
$0-$20,000	645 (24.9)
$20,001 - $40,000	542 (20.9)
$40,001 - $60,000	416 (16.1)
≥ $60,000	986 (38.1)

Characteristic	N (%)
Marital Status	
Married/Living w partner	1785 (62.7)
Wid., Div., Sep., Never married	1063 (37.3)
Employment Status	
Employed Now	1562 (59.1)
Unemployed Now	1080 (40.9)
Household Size	
1-2	735 (25.8)
3-4	1465 (51.4)
5-6	559 (19.6)
≥ 6	93 (3.3)

WAVE 1

MAIN FINDINGS & "EXPOSURE ASSESSMENT"
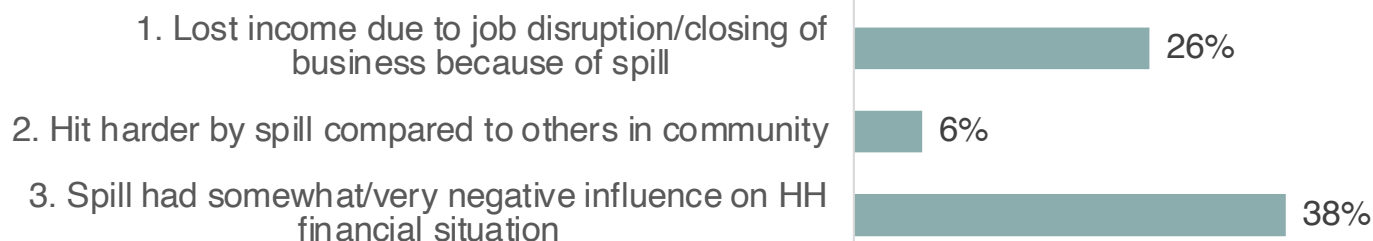## JULY 2012-AUGUST 2014

Methods

- Multivariate logistic regression was performed to estimate odds ratios (OR) and 95% confidence intervals (CI) for the relationships between exposure to the oil spill and physical health symptoms

- Poisson regression models with robust variances were used to calculate relative risks (RRs) and 95% confidence intervals (CIs) of the association between oil spill exposure and depression, mental distress and domestic conflict.

- All models were adjusted for age, race, and income.
  - Education was adjusted in the mental health models.
  - Time since spill was also adjusted for in the domestic conflict models and was not related to either physical health, depression or mental distress.

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Self-Reported Exposure To The Oil Spill

Economic Exposure

1. Lost income due to job disruption/closing of business because of spill — 26%

2. Hit harder by spill compared to others in community — 6%

3. Spill had somewhat/very negative influence on HH financial situation — 38%

Physical Exposure

4. Spill caused damage to areas fished commercially — 7%

5. Any smell exposure — 38%

6. Came into physical contact with oil in other ways — 22%

7. Spill directly affected recreational activities of HH — 34%

8. Worked on oil spill clean-up activities — 2%

9. Property lost/damaged due to oil spill or clean-up — 3%

0.00   0.10   0.20   0.30   0.40   0.50   0.60   0.70

% of Sample Experiencing Exposure

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"High" Economic Exposure & Physical Health

Peres et al. EHP, 2016.

"High" Economic Exposure & Mental Health

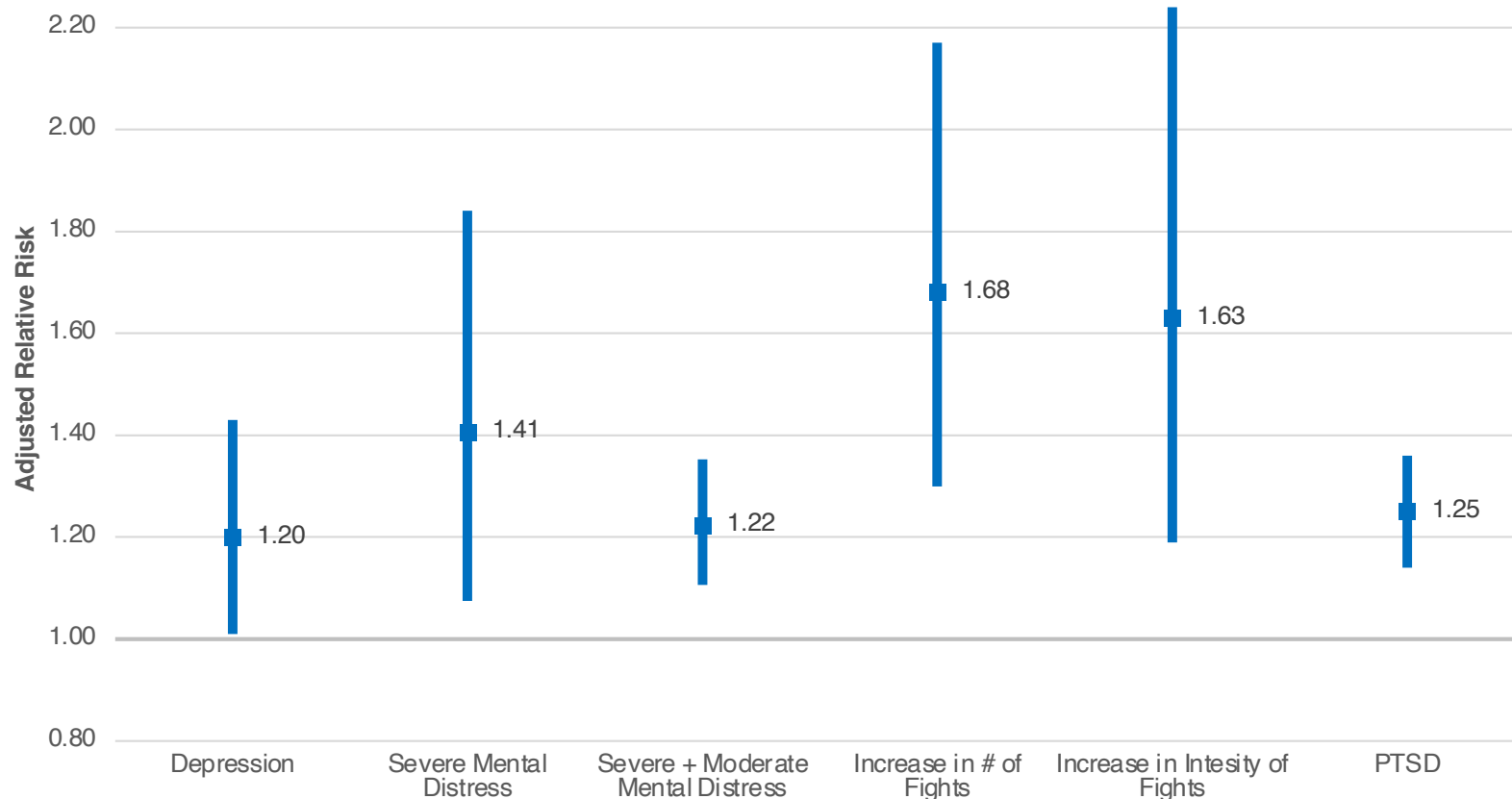All except mental distress significant at the Bonferroni adjusted alpha level, p< 0.0038
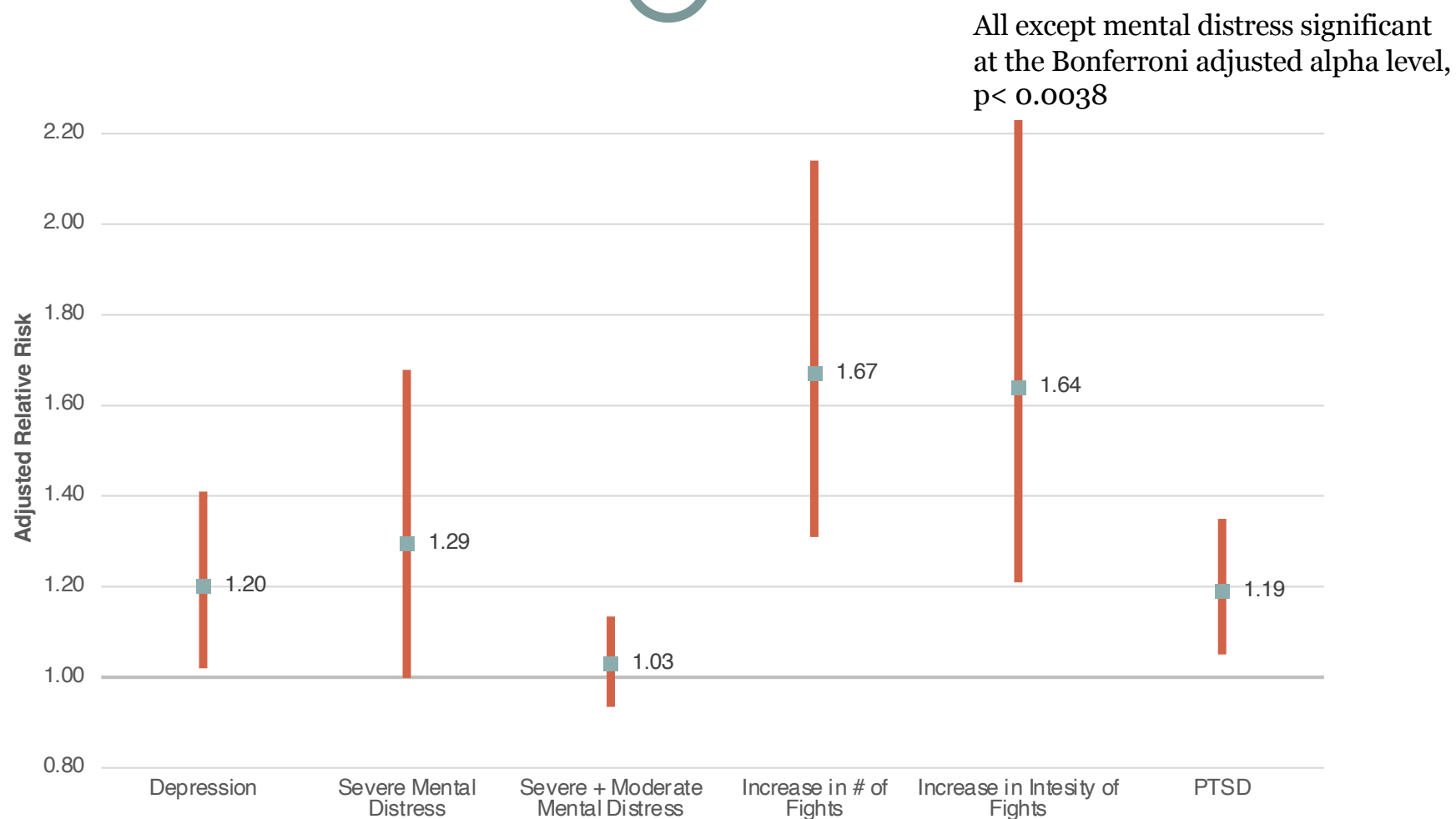
Rung et al. EHP, 2016.

"High" Physical Exposure & Mental Health

All significant at the Bonferroni adjusted alpha level, p< 0.0038

Rung et al. EHP, 2016.

Wave II

ASSESSED FOUR TO FIVE YEARS POST DWOS, N=2038

Methods

- Generalized estimating equations (GEE) and rate ratios to estimate the association between mental health outcomes and oil spill exposure & time since the oil spill.
  - Assumed Poisson distribution as both outcomes were highly right-skewed.
  - All models adjusted for age at oil spill, race, income, education.
 - Interactions between time and exposures also assessed and found non-significant.

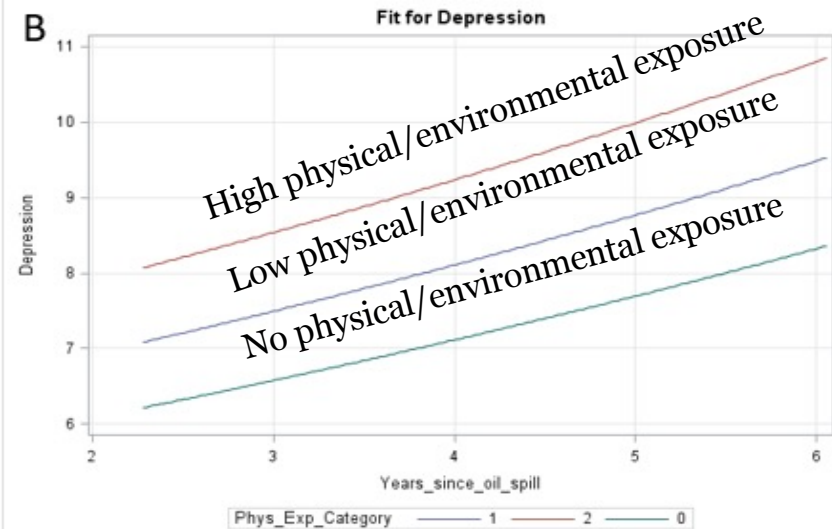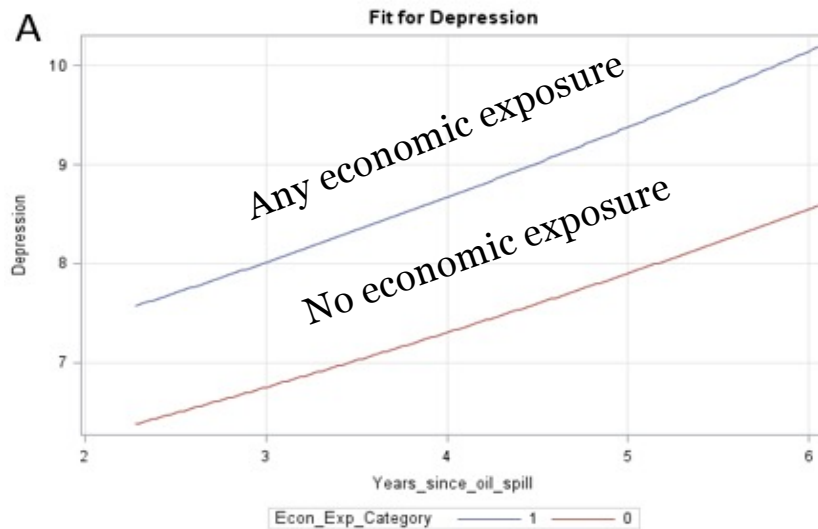# DWH Exposure & Mental Health

Risk Ratio for Depressive Symptoms

Predictor	Risk Ratio	95% CI	
Physical exposure	1.11	1.06	1.14
Economic exposure	1.08	1.04	1.13
Years since DHOS	1.08	1.06	1.11

Risk Ratio for Mental Distress

Predictor	Risk Ratio	95% CI	
Physical exposure	1.11	1.07	1.13
Economic exposure	1.05	1.01	1.08
Years since DHOS	0.97	0.95	0.99

Mental Health Symptoms over time
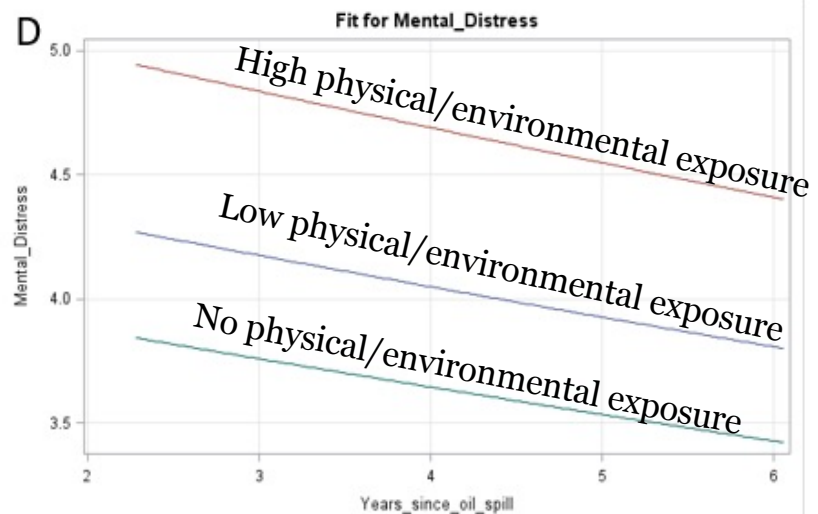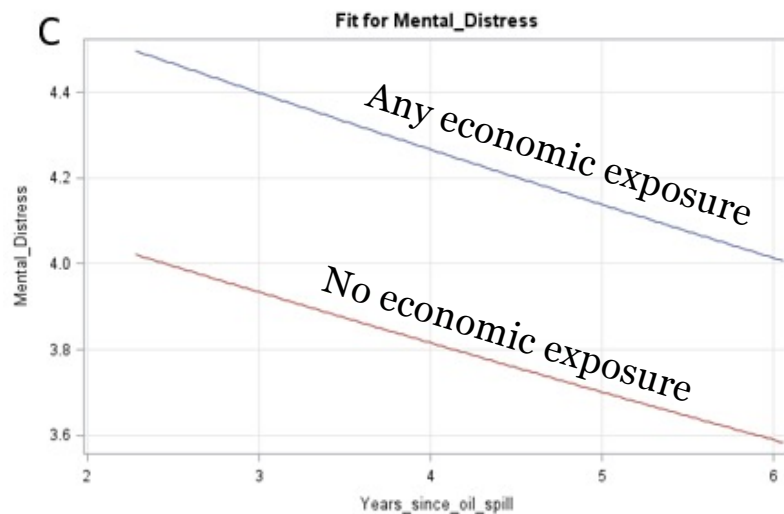
Pathways Between Oil Spill Exposure & Depression

SOCIAL TIES & HEALTH

Potential Pathways

- Neighborhoods (Gaston et al)
  - Environments where people live
  - Neighborhood conditions such as economic disadvantage and physical disorder are stressors that are sometimes associated with depression
- Social ties (Rung et al)
  - How people socialize, live, interact, relate to each other
  - Evidence linking social ties with health

Mental Health & Social Ties

- Evidence supports a relationship between exposure to disaster, including oil spills and the DHOS, and adverse mental health consequences.
- The mechanisms behind this relationship are unclear.
  - Do the <u>economic consequences</u> of a disaster lead to increased stress, subsequently leading to poor mental health?

  Or

  - Does the aftermath of a disaster lead to deteriorated social ties, subsequently leading to poor mental health?
- Need to elucidate pathways by which specific aspects of social ties lead to improvement of psychological well-being, particularly within disaster context.

What are Social Capital & Social Support?

- Social capital
  - Degree of connectedness and the quality and quantity of social relations in a given population
  - Structural social capital
    - Extent and intensity of associational links or activity (what people "do" in terms of social relations)
      - Participation in neighborhood organizations
  - Cognitive social capital
    - Perceptions of support, reciprocity, sharing, and trust (what people "feel")
      - Sense of community, informal social control
- Social support
  - Helping behaviors within family and friend networks, emotional sustenance, instrumental aid
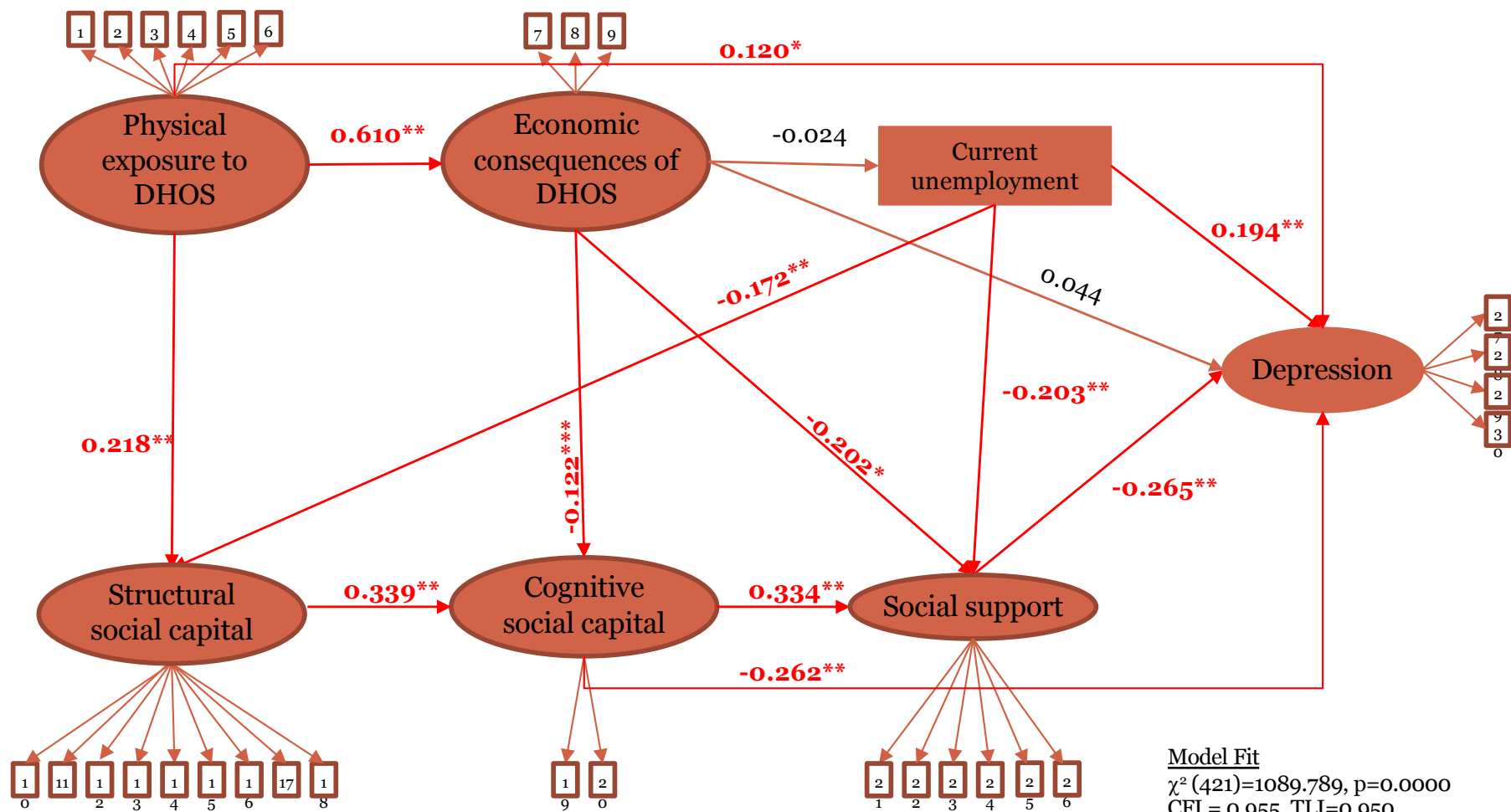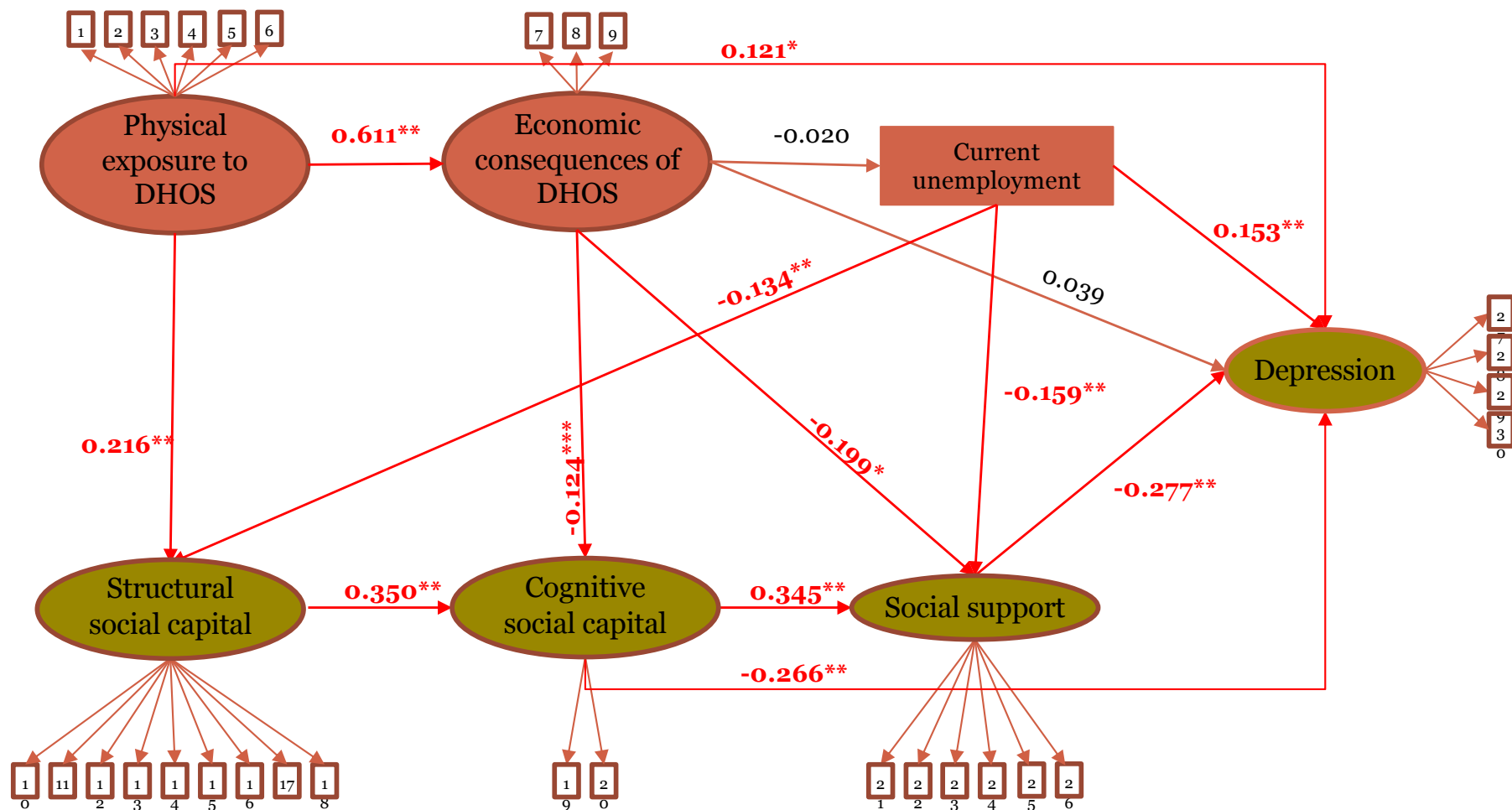
Model Fit
$\chi^2 (421)=1089.789$, p=0.0000
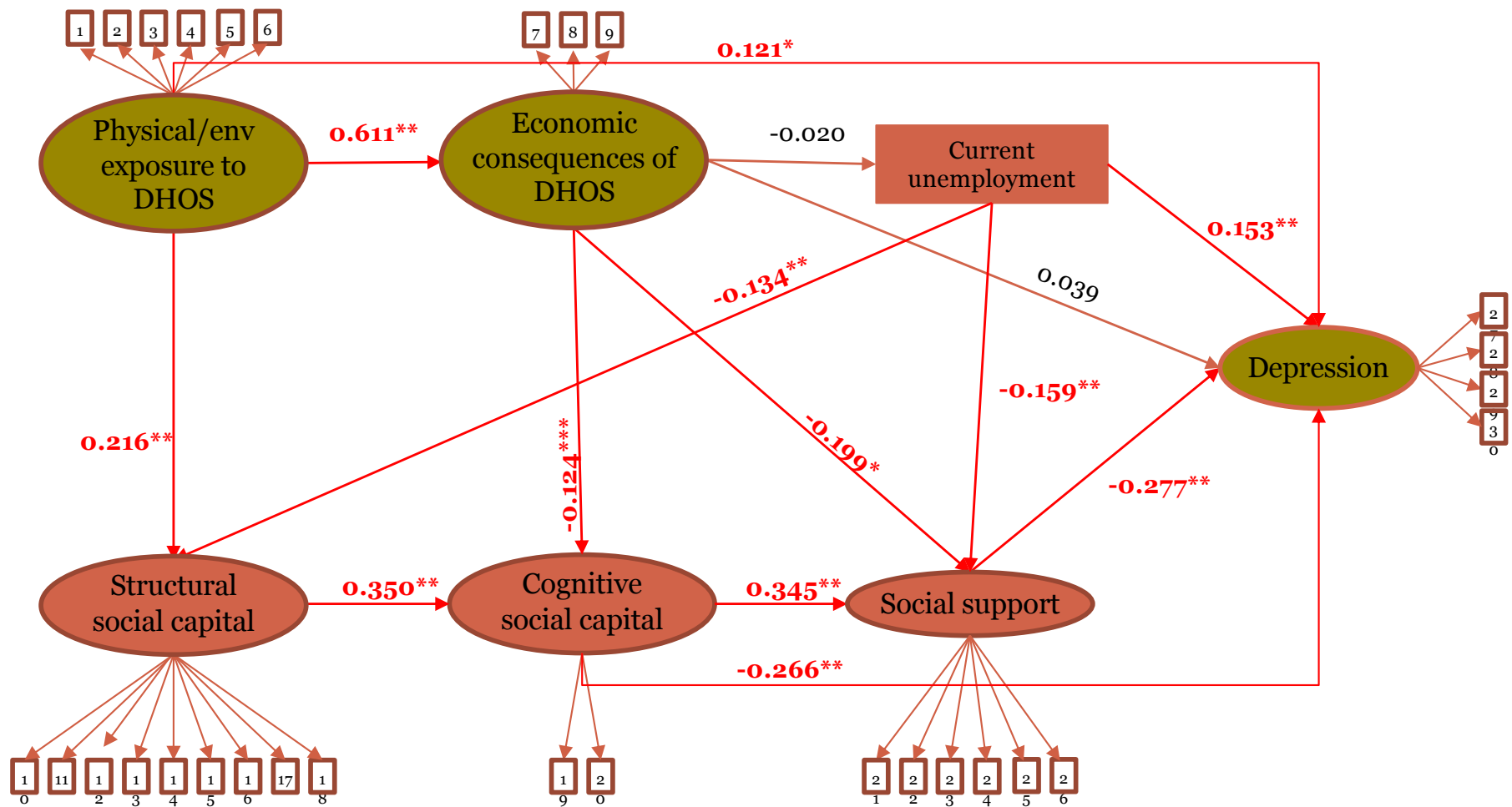CFI = 0.955, TLI=0.950
RMSEA = 0.024 (0.022-0.025)
WRMR = 1.525

†p<.10; *p<.05; **p<.005

Rung AL, Gaston S, Robinson WT, Trapido EJ, Peters ES. Untangling the disaster-depression knot: The role of social ties after Deepwater Horizon. *Social Science & Medicine.* 2017;177:19-26.

Rung et al, 2017

†p<.10; *p<.05; **p<.005
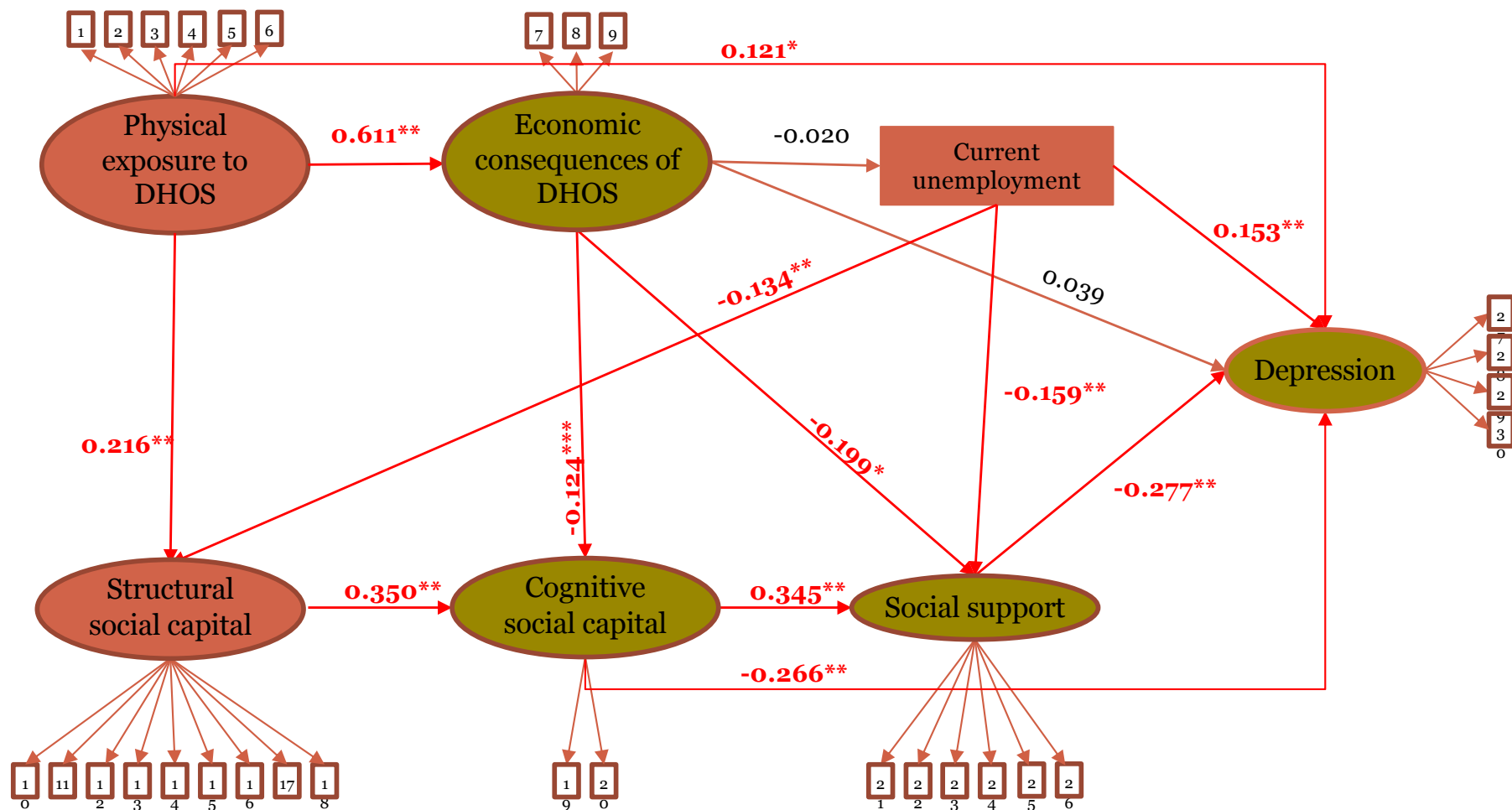
†p<.10; *p<.05; **p<.005

Rung et al, 2017

†p<.10; *p<.05; **p<.005

Rung et al, 2017

71% of the effect of economic exposure on depression is explained by cognitive social capital and social support.

Mental Health & Social Ties: Conclusion

- Social capital exerts its influence on depression via structural social capital, cognitive social capital, and social support.
  - Social context protective against depression
  - Social context also negatively affected by oil spill disaster
- Evidence supports the Social Support Deterioration Theory
  - Exposure to economic consequences of oil spill erodes both social capital and social support, accounting for the negative impact of exposure on depression.
- Implication:
  - Efforts to bolster the social context could be explored to mitigate mental health effects of disasters.

7R01AG069609-02

THE IMPACT OF ENVIRONMENTAL STRESSORS ON CHRONIC DISEASE DISPARITIES IN WOMEN

FUNDED BY NIA

PROJECT PERIOD BEGIN DATE: 07/15/2021

CURRENT AWARD NOTICE DATE: 12/09/2021

Project Funding Information for 2021		
Total Funding	Direct Costs	Indirect Costs
$634,196	$476,914	$157,282

PAR-19-372

Social Epigenomics Research Focused on Minority Health and Health Disparities

Grant Leadership

- Multi-PI Grant
  - ESP (LSU now UNMC) - Contact PI/ Project Leader
  - Nicole Nugent (Brown)
  - Alicia Smith (Emory)
- Co-I
  - Ariane Rung (LSU)

Overall Objective of Grant

- To determine the impact of social stressors on
  - <u>epigenetic age acceleration</u> and chronic health disparities
    - to test whether the social environment, individual health behaviors, and race/geography/SES
      - modify or mediate the association between traumatic stress and health (disparities),
        - directly or indirectly through biologic age acceleration

Backround

- The impact of stress and trauma is pronounced in communities with limited resources;
  - health disparities are influenced by a complex interplay of intra- and inter-individual differences in social and physical environments,
    - adversity throughout the life-course conferring a cumulative burden on stress sensitive psychological and physical health outcomes.
    - Age-related diseases prevalent in minority, rural, and low-income populations.
  - Lifelong experiences may alter biological processes through DNA methylation (DNAm), a modification that can alter gene expression.
    - Recent methods permit the use of DNAm to assess biological aging, and emerging research suggests that trauma and stress may accelerate DNAm age.

Aims

- To measure the association between cumulative trauma burden and racial/economic/geographic disparities in psychological health (PTSD, depression), physical health (medical history, self-reported physical health), and DNAm age acceleration

- To examine the mediating and moderating influences of the social environment and individual level behaviors that may mitigate or exacerbate the effects of cumulative trauma burden on negative psychological health, physical health, and DNAm age acceleration outcomes

- To characterize psychological and biological aging resilience processes, defined by psychological resilience as well as DNAm age deceleration, as influenced by social and health behavior

Goals

- Use the WaTCH cohort of 2800 women.
  - A third wave of data and biospecimen collection.
    - Self-reported health data on demographic, income, and financial stressors, oil spill exposure, neighborhood context, social capital, health behaviors, trauma history, psychological symptoms, and physical health will be collected through telephone interviews.
    - Repeat blood samples will be collected from up to 1058 women with baseline samples.

Conceptual Model
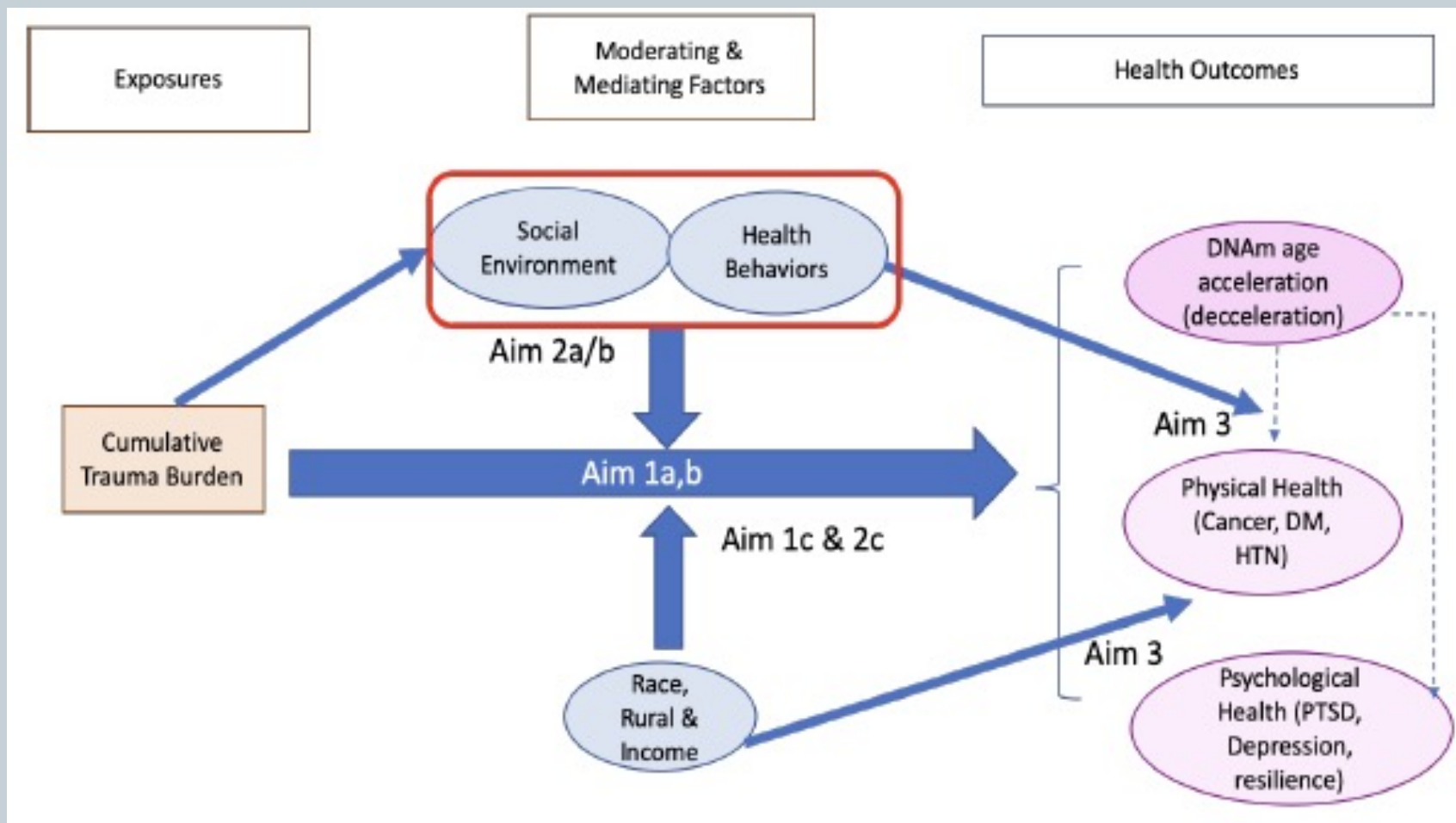
Significance

- Impact of *Disasters* on Communities
- Louisiana (LA) and the Gulf Region. Racial, economic, and geographic disparities in life expectancy are widening
- <u>Epigenetics</u> and Disparities in Health and Aging
- Health *Behaviors* and Individual Differences
- <u>Social</u> Environment
- *Resilience* and Successful *Aging*
- Understanding and Reducing Health <u>Disparities</u>
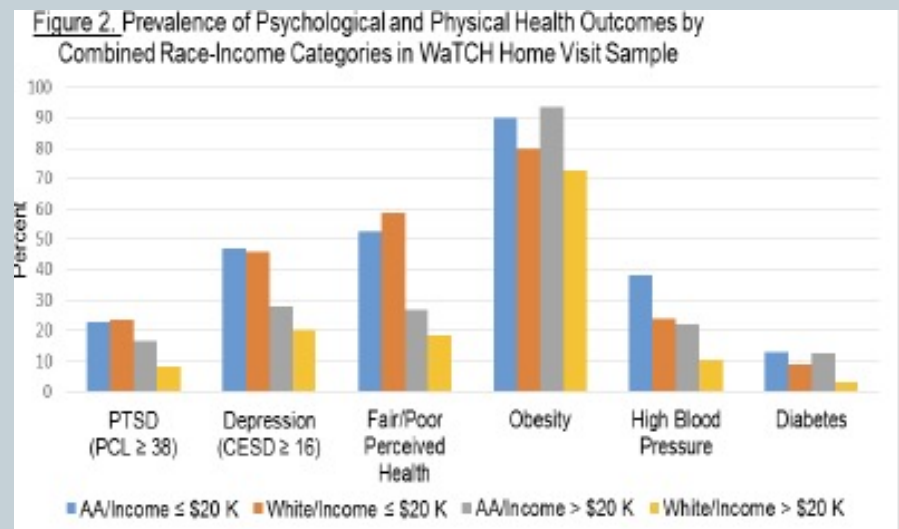
Innovation

- The WATCH Study: A Unique Sample
- Epigenetic Methods and DNAm Age Acceleration/Deceleration: A Paradigm Shift in Context
- Translation into Prevention and Intervention

Approach

- Preliminary data
  - Adversity in the WaTCH Cohort
  - Stress Sensitive Disorders in the WaTCH Cohort
  - Disparities in Black and Low-Income Participants
  - Neighborhood Context
  - Social Context
  - (DNAm aging)

Figure 2. Prevalence of Psychological and Physical Health Outcomes by Combined Race-Income Categories in WaTCH Home Visit Sample

Biologic (DNAm) Aging

- Epigenetic (Methylation) Age Acceleration
  - Epigenetic aging is a novel measure of biological age, reflecting exposures and disease risks independent of chronological age. It may serve as a useful biomarker of health or disease risk for early detection or prevention
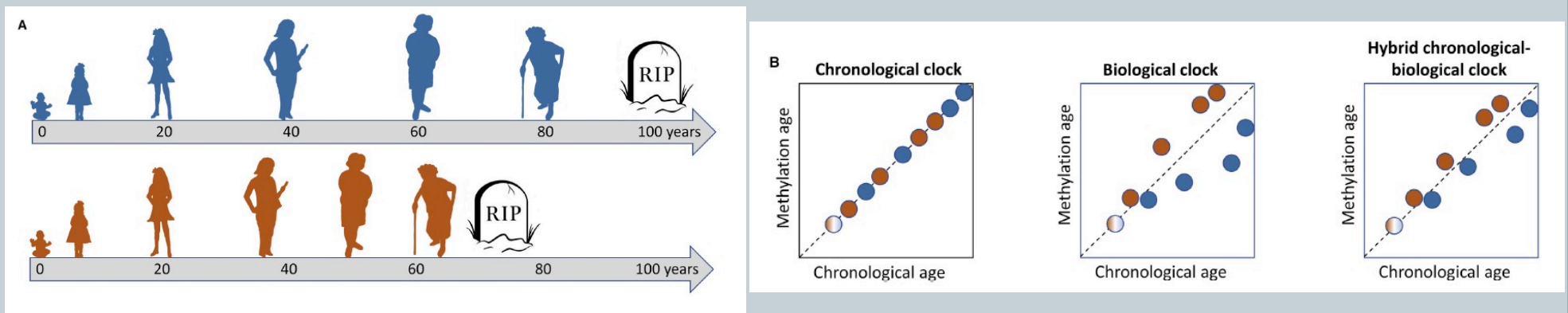
Field AE, et al., Mol Cell. 2018 Sep 20;71(6):882-895

Study Design

- 3rd wave of telephone interviews (CATI & REDCaP)
  - Retention, recruitment, compensation
- Blood acquisition, management, and storage (archive & new)
- Data management
  - REDCap & OpenSpecimen
- Measures (exposures & outcomes) PhenX Toolkit, NIH Common Data Elements
  - Demos, SES, Stress, neighborhood, social, SRD, behavior, resilience
- Biologic methods
  - DNA Methylation EPIC BeadChip (Illumina)
    - DNAm age will be calculated using methods described by Levine (PhenoAge) and Lu (GrimAge). Each method estimates age from DNA methylation of different sets of CpG sites and is trained to reflect age-related health risk and mortality
- Statistical analysis (R and Mplus)
  - latent growth curve models
    - interaction term for latent social context
    - psychological and biological indexes of resilience will be correlated over time, and positive health and social behaviors will drive changes in psychological and biological aging over time,

New Challenges

- Human Subject Protection
  - LSUHSC to remain single IRB of record
  - NIH Genomic Data Sharing plan

- Replace LSU Epidemiology Data Center with UNMC
  - "The EDC provides biostatistical, epidemiological, and study design support for health-related research and practice projects"
  - Database
    - REDCap (LSU vs UNMC)
      - Participant tracking
      - Questionnaires
  - Interviews
    - UNL Bureau of Sociologic Research

- Blood Collection
  - ExamOne: a division of Quest Diagnostics. The ExamOne Clinical Research & Academic Studies offers mobile specimen and data collection, medical records retrieval and abstraction services that get clinical trials and population studies
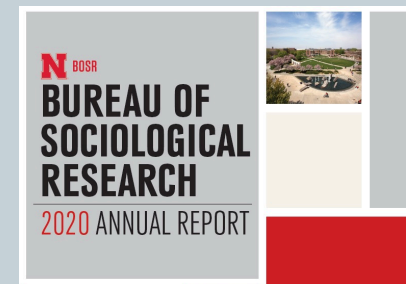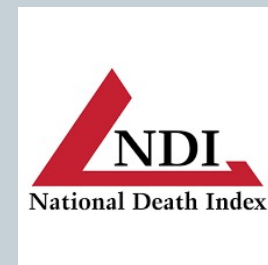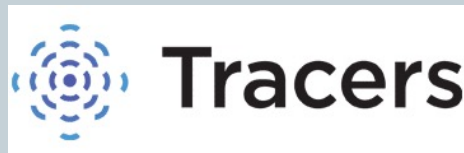
Tasks

- Specimen Tracking Biorepository
- Shipping samples
  - LSU Lab to Emory
  - Participants to Emory

Proposed Study Activities	Years				
	1	2	3	4	5
Recontact & interview participants		■	■		
Collect Blood Specimens		■	■		
Process blood specimens & DNA extraction			■	■	
Methylation analysis				■	
Integrate data				■	
Statistical analysis					■
Manuscript preparation					■

Timeline

- Develop questionnaire, interview infrastructure
- Hire project coordinator ✓

  - Participant tracking, recontact
  - Develop study manual of operations
- REDCap databases

LexisNexis® RISK SOLUTIONS

Tracers

NDI National Death Index

Public Health Relevance Statement

- This study will inform the development of behavioral and biological approaches for novel interventions aimed at preventing and reducing health disparities in women. It will also extend understanding of the environment's effect on the impact of DNAm age acceleration of chronic disease disparities.

Acknowledgements

- This research was supported by:
  - NIEHS U01ES021497
  - 7R01AG069609-02
  - UNMC VCR Office
  - UNMC Dean's Office
- We would like to thank all the women and children who have participated in the study, as well as the WaTCH research staff (past, present, & future).

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