A. OVERALL COVER PAGE

Project Title: Intergenerational Transmission of Trauma in WTC Responders with PTSD	
Grant Number: 1U01OH012065-01	**Project/Grant Period:** 07/01/2020 - 06/30/2021
Reporting Period: 07/01/2020 - 06/30/2021	**Requested Budget Period:** 07/01/2020 - 06/30/2021
Report Term Frequency: Final	**Date Submitted:** 10/10/2023
Program Director/Principal Investigator Information: YAEL M CYCOWICZ , PHD **Phone Number:** (646) 774-5837 **Email:** Yael.Cycowicz@nyspi.columbia.edu	**Recipient Organization:** NEW YORK STATE PSYCHIATRIC INSTITUTE dba RESEARCH FOUNDATION FOR MENTAL HYGIENE, INC 1051 Riverside Drive NEW YORK, NY 100321007 **DUNS:** 167204994 **UEI:** TYVNMW8FNQQ3 **EIN:** 1141410842A2 **RECIPIENT ID:**
Change of Contact PD/PI: No	
Administrative Official: JANELLE GREENHILL 1051 RIVERSIDE DRIVE UNIT #33 NEW YORK, NY 10032 **Phone number:** 646-774-6500 **Email:** nga@nyspi.columbia.edu	**Signing Official:** JANELLE GREENHILL 1051 RIVERSIDE DRIVE UNIT #33 NEW YORK, NY 10032 **Phone number:** 646-774-6500 **Email:** nga@nyspi.columbia.edu
Human Subjects: NA	**Vertebrate Animals:** NA
hESC: No	**Inventions/Patents:** No

B. OVERALL ACCOMPLISHMENTS

B.1 WHAT ARE THE MAJOR GOALS OF THE PROJECT?

We propose to create a new cohort of now-adult children, who were younger than 18 years of age during the 9/11 terror attack, and whose parents were either WTC-pR or WTC-wR and developed 9/11 related-PTSD. For this purpose, we invited WTC responder (WTC-R) parents, along with their now-adult children, to participate in a web-based study.
To better understand WTC-related ITT, we will assess the psychological well-being of the WTC-R offspring using an online battery of instruments measuring both psychiatric symptoms and cognitive and emotional functions in relation to their parents' extremely well-documented and longitudinally followed (4+ waves) mental and somatic sequelae of their 9/11 trauma. We will also compare the children of WTC-pR with those of WTC-wR, and those of WTC-R parents that were primary caregivers with those of their spouses/partners to further clarify the nature of ITT. We plan to enroll 600 parents and 900 children.

Specific Aims:

1. Establish a new cohort of offspring of WTC-R with PTSD to evaluate: a) the level of psychiatric, behavioral, and cognitive/emotional functioning, and b) the roles of WTC-R occupation, 9/11 parental exposure (e.g., type, duration), and caregiving role of the WTC-R parent (i.e. primary vs. secondary, full vs. part-time, mother vs. father) on these outcomes.

Hypotheses: Levels of psychiatric, behavioral, and cognitive/emotional functioning will be lower: a) among the youngest group compared to the oldest; b) among offspring of WTC-wR compared to WTC-pR, and; c) among children of WTC-R parents with greater caregiving roles.

2. Identify ITT pathways by examining factors that mediate associations between parental 9/11 exposure and offspring's psychiatric, behavioral, and cognitive/emotional functioning.

Hypotheses: ITT is mediated by: a) parental symptoms and trajectories of PTSD and comorbid disorders, b) parental physical health trajectories, c) parental occupation and employment, SES, social and family support; d) parenting style; and e) increased offspring exposure to trauma, and life stressors.

B.1.a Have the major goals changed since the initial competing award or previous report?

No

B.2 WHAT WAS ACCOMPLISHED UNDER THESE GOALS?

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B.3 COMPETITIVE REVISIONS/ADMINISTRATIVE SUPPLEMENTS

For this reporting period, is there one or more Revision/Supplement associated with this award for which reporting is required?

No

B.4 WHAT OPPORTUNITIES FOR TRAINING AND PROFESSIONAL DEVELOPMENT HAS THE PROJECT PROVIDED?

NOTHING TO REPORT

B.5 HOW HAVE THE RESULTS BEEN DISSEMINATED TO COMMUNITIES OF INTEREST?

Dr. Cycowicz gave a public talk via NIOSH during the March 9, 2023, research webinar. The talk is available to the public on YouTube on the WTC Health Program channel under the title, "Intergenerational Transmission of Trauma in WTC Responders with PTSD".

B.6 WHAT DO YOU PLAN TO DO DURING THE NEXT REPORTING PERIOD TO ACCOMPLISH THE GOALS?

Not Applicable

B.2 (B.2 Accomplishments.pdf)

B.2 Accomplishments

During this period, we completed online data collection from both WTC-R parents and their children. For all of our participants we have a wealth of mental health and cognitive data. We have thorough demographic characteristics of this sample (for both parents and their now-adult children), including age, biological sex, race, ethnicity, education, marital status, employment, family income and number of children. Similarly, we have comprehensive assessments of the participants mental health. We have assessed PTSD using PCL-5, depression using PHQ-8, Anxiety using Gad-7, Panic using PDSR, substance use disorder using Audit for alcohol use (AUD) and DAST-10 for non-prescription drugs. We also assessed life stressors using LEC, and a short form of PCL for Covid-19. Our study also included assessments of physical health, social support and cognitive functioning. In addition, we have received the prior waves of mental health data of the WTC-R parents that is incorporated into our data collection.

We have accomplished the goal of the first aim by establishing a new cohort of WTC-R with PTSD and their offspring. We have data from a total of 446 participants composed of 176 parents and 270 children.

Analyzing the demographic data of these participants, we have a well characterized sample of the WTC-R parents and of their children. This demographic analysis of our new cohort demonstrates an age-appropriate shift between WTC-R parents and children. In particular, we found a positive shift in education and income such that the younger generation is more educated and have higher income compared to their WTC-R parents.

We also have a comprehensive characterization of the participants mental health status. Our data demonstrate that parental exposure to the acute 9/11 trauma not only impairs the mental health of parents but also puts the children at risk to develop mental health disorders themselves. Specifically, we found that both WTC-R parents and their offspring have high rates of depression (31.82% and 21.85%), anxiety (24.43% and 25.19%), panic (30.6% and 27.40%), and AUD (8.52% and 17.1%). In addition, we found that over 10% of the now-adult children had Covid-19 like-PTSD (compared to only 4.56% among the parents).

To accomplish the second aim of this study, which proposed to investigate pathways of ITT, we tested the association between the parent and offspring characteristics with the offspring psychiatric outcomes using multivariable logistic regression models. To account for correlation for multiple children within a family, we used Generalized Estimating Equations. We found that parental depression is associated with children's depression, and parental panic disorder is associated with children's PTSD. Furthermore, we observed biological-sex effects such as being a WTC-R female parent is associated with child's depression and anxiety disorder, whereas being a daughter is associated with higher risk of PTSD and Panic disorder but lower risk of AUD. We also found that the children's own traumas play an important role in their mental health outcomes which was seen as increased risk of AUD and Panic disorder. Furthermore, children's scores for Covid-19 PCL are associated with PTSD, Anxiety and Panic disorders. Our findings also indicated that an important protective mechanism for reducing mental disorder risk in offspring of WTC-R with PTSD is social support. Children with social support were more resilient and showed less depression, anxiety and AUD. Overall, the initial study results show compelling evidence that trauma transmission from a PTSD parent to their offspring is evidenced as a host of mental health issues, not just PTSD, in the offspring. The transmission may be moderated by parental and offspring biological-sex, offspring's own traumas and the social environment.

We included cognitive functioning as another measure of overall mental health as it is often impaired in people with mental disorders. The initial analysis of the emotion recognition task assessing ability to quickly recognizing positive and negative facial expressions (e.g., happy vs. sad) revealed an expected age difference. We found that the now-adult children committed significantly less errors and were significantly faster ($p<0.0001$) than their parents. Additionally, there was significant interaction ($p<0.02$) between groups (parent vs. children) and accuracy of responses to the two classes of stimuli (positive and negative emotions). While parents were more accurate in detecting positive than negative emotion, the now-adult children were equally correct in detecting these two types of emotions ($p<0.02$). Furthermore, there was significant interaction ($p<0.001$) between groups (parent vs. children) and the reaction time for the two classes of stimuli (positive and negative emotions). While now-adult children were faster to recognize positive than negative faces, their parents were faster to respond to negative emotions. These findings point to differences in perception of negative stimuli. Children took more time to process negative facial expression and therefore were more accurate in detecting negative emotion than the

parents. While we need to further investigate the association between task performance with mental health status, it is possible that this difference across groups reflect differences in emotion regulation mechanisms between the parents and their now-adult children.

Challenges: We anticipated a much larger cohort with about a 20% response rate of the WTC-R. We emailed invitation letters to 2,431 WTC-R, and therefore estimated that about 480 parents would enroll in the study. Indeed, 525 WTC-R parents signed consents indicating that they were interested in our study. However, there were two major reasons for the large drop in this number. First, parents could not complete the study unless at least one of their children enrolled and completed the study. Many children refused to participate perhaps because they are less connected to the 9/11 experience and did not care to participate. Second, many parents wanted to protect their children from “anything to do with 9/11”, and thus refused to share with us their children’s contact information. As we investigated this issue more deeply, we believe that in future studies we could devise a better way to encourage parents and children to enroll in a family study. Our initial reported findings indicate that such a study could provide invaluable information regarding who are at risk children, and how to specifically protect them from developing mood disorders.

C. OVERALL PRODUCTS

C.1 PUBLICATIONS

Are there publications or manuscripts accepted for publication in a journal or other publication (e.g., book, one-time publication, monograph) during the reporting period resulting directly from this award?

No

C.2 WEBSITE(S) OR OTHER INTERNET SITE(S)

NOTHING TO REPORT

C.3 TECHNOLOGIES OR TECHNIQUES

NOTHING TO REPORT

C.4 INVENTIONS, PATENT APPLICATIONS, AND/OR LICENSES

Have inventions, patent applications and/or licenses resulted from the award during the reporting period? No

If yes, has this information been previously provided to the PHS or to the official responsible for patent matters at the grantee organization? No

C.5 OTHER PRODUCTS AND RESOURCE SHARING

NOTHING TO REPORT

D. OVERALL PARTICIPANTS

D.1 WHAT INDIVIDUALS HAVE WORKED ON THE PROJECT?

Commons ID	S/K	Name	Degree(s)	Role	Cal	Aca	Sum	Foreign Org	Country	SS
YCYCOWICZ	Y	CYCOWICZ, YAEL M	PHD	PD/PI	3.0	0.0	0.0			NA
POSTAVA	Y	CHESLACK-POSTAVA, KEELY R	BS,MOTH,PHD	PD/PI	1.5	0.0	0.0			NA
DR2097	Y	Rodriguez Moreno, Diana	PHD	PD/PI	2.2	0.0	0.0			NA
FEDERADRI	Y	Feder, Adriana	MD	Co-Investigator	1.1	0.0	0.0			NA
	N	Cuchacovich, Sharon		Non-Student Research Assistant	3.3	0.0	0.0			NA
	N	Solomon, Sydney		Non-Student Research Assistant	8.5	0.0	0.0			NA
	N	Lakew, Bereketab		Technician	4.0	0.0	0.0			NA
	N	Fan, Bin		Statistician	4.0	0.0	0.0			NA

Glossary of acronyms:
S/K - Senior/Key
Cal - Person Months (Calendar)
Aca - Person Months (Academic)
Sum - Person Months (Summer)
Foreign Org - Foreign Organization Affiliation
SS - Supplement Support
RS - Reentry Supplement
DS - Diversity Supplement
OT - Other
NA - Not Applicable

D.2 PERSONNEL UPDATES

D.2.a Level of Effort

Not Applicable

D.2.b New Senior/Key Personnel

Not Applicable

D.2.c Changes in Other Support

Not Applicable

D.2.d New Other Significant Contributors

Not Applicable

D.2.e Multi-PI (MPI) Leadership Plan

Not Applicable

E. OVERALL IMPACT

E.1 WHAT IS THE IMPACT ON THE DEVELOPMENT OF HUMAN RESOURCES?

Not Applicable

E.2 WHAT IS THE IMPACT ON PHYSICAL, INSTITUTIONAL, OR INFORMATION RESOURCES THAT FORM INFRASTRUCTURE?

NOTHING TO REPORT

E.3 WHAT IS THE IMPACT ON TECHNOLOGY TRANSFER?

Not Applicable

E.4 WHAT DOLLAR AMOUNT OF THE AWARD'S BUDGET IS BEING SPENT IN FOREIGN COUNTRY(IES)?

NOTHING TO REPORT

G. OVERALL SPECIAL REPORTING REQUIREMENTS SPECIAL REPORTING REQUIREMENTS

G.1 SPECIAL NOTICE OF AWARD TERMS AND FUNDING OPPORTUNITIES ANNOUNCEMENT REPORTING REQUIREMENTS

NOTHING TO REPORT

G.2 RESPONSIBLE CONDUCT OF RESEARCH

Not Applicable

G.3 MENTOR'S REPORT OR SPONSOR COMMENTS

Not Applicable

G.4 HUMAN SUBJECTS

G.4.a Does the project involve human subjects?

Not Applicable

G.4.b Inclusion Enrollment Data

File(s) uploaded:
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G.4.c ClinicalTrials.gov

Does this project include one or more applicable clinical trials that must be registered in ClinicalTrials.gov under FDAAA?

G.5 HUMAN SUBJECTS EDUCATION REQUIREMENT

NOT APPLICABLE

G.6 HUMAN EMBRYONIC STEM CELLS (HESCS)

Does this project involve human embryonic stem cells (only hESC lines listed as approved in the NIH Registry may be used in NIH funded research)?

No

G.7 VERTEBRATE ANIMALS

Not Applicable

G.8 PROJECT/PERFORMANCE SITES

Not Applicable

G.9 FOREIGN COMPONENT No foreign component
G.10 ESTIMATED UNOBLIGATED BALANCE Not Applicable
G.11 PROGRAM INCOME Not Applicable
G.12 F&A COSTS Not Applicable

Cumulative Inclusion Enrollment Report

This report format should NOT be used for collecting data from study participants.

Study Title: Intergenerational Transmission of Trauma in WTC Responders with PTSD

Comments:

Racial Categories	Ethnic Categories									Total
	Not Hispanic or Latino			Hispanic or Latino			Unknown/Not Reported Ethnicity			
	Female	Male	Unknown/ Not Reported	Female	Male	Unknown/ Not Reported	Female	Male	Unknown/ Not Reported	
American Indian/ Alaska Native	0	1	0	0	0	0				**1**
Asian	2	2	0	0	0	0				**4**
Native Hawaiian or Other Pacific Islander	0	0	0	0	0	0				**0**
Black or African American	12	2	0	0	13	0				**27**
White	119	163	2	23	37	1				**345**
More Than One Race	7	2		19	8					**36**
Unknown or Not Reported	2	10	0	5	9	0	1	3	3	**33**
Total	**142**	**180**	**2**	**47**	**67**	**1**	**1**	**3**	**3**	**446**

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OMB No. 0925-0001/0002
Cumulative Inclusion Enrollment Report

I. OVERALL OUTCOMES

I.1 What were the outcomes of the award?

A parent's experience of trauma has been shown to impact the psychological well-being of their children even when the children themselves were not directly exposed to the traumatic event. Research on the Intergenerational Transmission of Trauma (ITT) has demonstrated behavioral, cognitive, and emotional difficulties in offspring of traumatized parents, including hypervigilance, nightmares, difficulties in interpersonal functioning, deficits in academic performance, along with mood and other psychiatric disorders. Studies examining the effects of trauma transmission from parents with post-traumatic stress disorder (PTSD), reported high rates of PTSD in their offspring. However, there is still debate regarding how the proposed pathways of ITT explain the increased risk for impaired psychological well-being in children of parents exposed to trauma. The burden of ITT has not received appropriate research consideration in children of World Trade Center Responders (WTC-R) given earlier reports of behavioral, psychological and health problems among these children, and evidence suggests that these difficulties and disorders persist beyond the childhood years. This study addressed this gap by establishing a new cohort of persons who were younger than 18 years of age at the time of the 9/11 terror attack, and whose parents developed PTSD after being exposed through their occupation to the terror attack and its aftermath. We have assessed the psychological well-being and risk factors of this cohort using an online battery and examined the possible pathways of ITT.

Our study included WTC responders that were at the 9/11 site either as police or recovery workers, and who developed PTSD as a result of their exposure to the attack. In addition, the responders who were invited to the study were those who at the time of the 9/11 attack, had children younger than 18 years old. Only those families in which both the parents and at least one now-adult children agreed to participate were included in the study. A total of 176 parents and 270 of their now-adult children completed the study. They all completed an online survey which included demographic questions, brief assessment of current mental health, past trauma exposures, questions about current physical health, their social support and cognitive functioning.

Our data showed a positive change in demographic characteristics between the WTC-R parents and their now-adult children. The children had more years of education and a greater income compared to their parents. Our study also showed that the parents' exposure to the acute 9/11 trauma not only impairs their own mental health but it also put their children at risk to develop mental health disorders. Indeed, the rate of probable mental disorders are high among both parents and offspring. Specifically, we found that both WTC-R parents and their offspring have high rates of depression (31.82 % and 21.85%), anxiety (24.43% and 25.19%), panic (30.6% and 27.40%), and AUD (8.52% and 17.1%). In addition, we found that over 10% of the now-adult children had Covid-19 like-PTSD (compared to only 4.56% among the parents). The transmission of mental health disorders from parents to children probably depends on many factors. Our study found that certain characteristics of parents or their children are more likely to enable such transmission. For example, children who have depression are more likely to have parents who have depression, and children with PTSD are more likely to have parents with panic disorder. When the WTC-R who was exposed to trauma is a mother, her children are more likely to have depression and anxiety disorder. If the now-adult child is a daughter then she is more likely to have PTSD and panic disorder, but less likely to have Alcohol use disorder. Children's own life experiences and trauma also play an important role in their mental health and with increased trauma experiences we found more panic disorder and alcohol use disorder among offspring. Furthermore, the effect of Covid-19 on the now-adult children was higher than in their parents, and was associated with PTSD, anxiety and panic disorders.

A more hopeful finding in our study points to an important way to reduce the risk of mental health disorders in children of trauma exposed parents. In our study of WTC responder parents, we found that having social support made the children more resilient and they showed less depression, anxiety, and alcohol use disorders. It appears that having interactions with other people in the child's environment can mitigate the effect of parents' mental health on their children. It could be that the social support provides other behavioral models from which they learn that lead them to have better mental health.

In summary, our study demonstrates that transmission of trauma from parents to offspring is not limited to PTSD symptoms. Psychopathology of the parents following the 9/11 trauma poses a risk for their children to develop their own mental health pathology, and this is more acute for females. Our findings about social support suggest that environment could reduce this

risk and change the course of life for these children. Our study shows the importance of understanding the pathways of trauma transmission across generations. Future studies replicating and extending our research are necessary to formulate effective interventions that could teach resilience in the face of mass disasters.