

The cognitive Impact of World Trade Center exposure among community members

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INTRODUCTION

- The World Trade Center Environmental Health Center (WTCEHC) is a federally designated clinical center for treatment and surveillance of community members (Survivors).
- Many survivors score positive for symptoms of Depression and PTSD on evaluation [1,2,3].
- Cognitive impairment (CI) is a significant health concern among individuals exposed to dust/fumes and psychological stress from World Trade Center (WTC) terrorist attack on September 11, 2001 [4]. The majority of patients in the WTCEHC are now over 60 years old and cognitive decline is an increasing health concern.
- CI among WTC First and General Responders has been extensively studied using validated instruments for measuring objective cognitive dysfunctions. Some examples are the Montreal Cognitive Assessment (MoCA) as well as subjective cognitive decline (SCD), and many have been linked to WTC dust exposures and PTSD symptoms. In depth studies of cognitive functions of WTC Survivors are lacking and needed.
- WTC community members (local residents, workers, students, and commuters passing by) were similarly exposed to WTC toxic dust/fumes and traumatizing scenes [4]. The community members include many women and have a variety of demographic profiles, social determinants of health, and different WTC dust exposure profiles than those seen in WTC first responders.
- We have reported a preliminary study of cognitive function among WTC EHC enrollees with mental health symptoms including PTSD and depression disorders [5]. The preliminary evidence of association between WTC exposure and cognitive decline is worthy of systematic investigation for general WTC-affected community members.

PURPOSE

To determine whether World Trade Center dust cloud exposure is associated with cognitive impairment.

METHODS

Study Participants: 255 individuals enrolled in the World Trade Center (WTC) community health study (U01OH012486).

Telephone Cognitive Assessments:

- Telephone Montreal Cognitive Assessment (t-MoCA)
- Episodic Memory: Craft Story immediate and delayed recall
- Verbal Fluency: Category naming (animals, vegetables) and letter naming (F, L)

Psychological & Social Surveys:

- Geriatric Depression Scale (GDS)
- Nine-item Patient Health Questionnaire (PHQ-9)
- Social Support Survey (SSS)

Statistical Analysis (Linear Regression Models):

- *Model 1:* Regressed t-MoCA, episodic memory, and verbal fluency scores on WTC dust cloud exposure status
- *Model 2:* Regressed t-MoCA, episodic memory, and verbal fluency scores on GDS, PHQ-9, and SSS scores
- Covariates: Age, sex, and race/ethnicity (Non-Hispanic White vs. non-White and/or Hispanic) adjusted for in all models

The Cloud in Lower Manhattan, South of Chambers Street



RESULTS

WTC Dust Cloud Exposure Effects:

- *Lower Episodic Memory:* Significantly associated ($\beta = -0.24$, 95% CI [-0.477, -0.004], $p = 0.047$)
- *Lower Verbal Fluency:* Significantly associated ($\beta = -0.24$, 95% CI [-0.467, -0.013], $p = 0.040$)
- t-MoCA: No significant association found

Depression Associations:

- *Episodic Memory:* Lower memory scores linked to depression only on the PHQ-9 ($\beta = -0.131$, 95% CI [-0.252, -0.01], $p = 0.034$)
- *Verbal Fluency:* Lower fluency scores linked to depression only on the GDS ($\beta = -0.117$, 95% CI [-0.234, 0], $p = 0.051$)
- *t-MoCA:* Lower cognitive screen scores linked to depression only on the GDS ($\beta = -0.161$, 95% CI [-0.283, -0.039], $p = 0.010$)

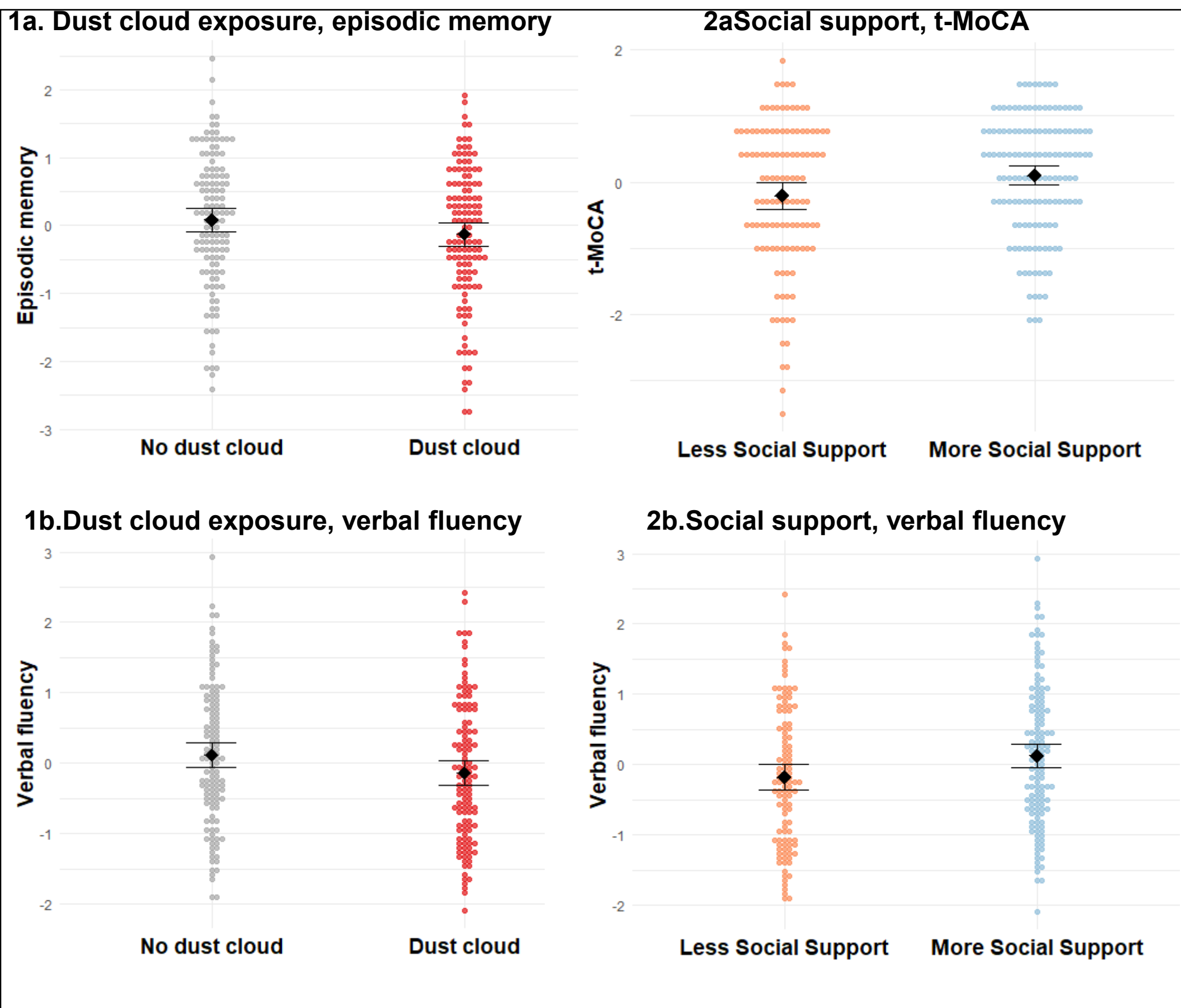
Social Support Survey Associations:

- *Higher Verbal Fluency:* Significantly linked to better social support ($\beta = 0.122$, 95% CI [0.007, 0.238], $p = 0.038$)
- *Higher t-MoCA:* Significantly linked to better social support ($\beta = 0.14$, 95% CI [0.019, 0.261], $p = 0.025$)

TABLE

Table 1. Group Demographics		
WTC dust cloud exposure:	No (n=127)	Yes (n=128)
Age at telephone assessment		
mean (SD)	65.3 (10.7)	66.4 (8.71)
median [IQR]	66 [59.6, 71.6]	66.4 [61.4, 72.8]
Sex, n (%)		
Female	83 (65%)	66 (52%)
Male	44 (35%)	62 (48%)
Race, n (%)		
White	54 (43%)	67 (52%)
Black/African American	26 (20%)	29 (23%)
Asian	7 (6%)	4 (3%)
Other/unknown	40 (31%)	28 (22%)
Non hispanic white, n(%)	51 (40%)	61 (48%)
Education, n(%)		
less than HS	6 (5%)	5 (4%)
HS	11 (9%)	17 (13%)
some collge	22 (17%)	23 (18%)
undergrad	47 (37%)	52 (41%)
graduate	41 (32%)	31 (24%)
Residence near WTC on 9/11	25 (20%)	19 (15%)
Work or school in/near WTC on 9/11	90 (71%)	100 (78%)

FIGURES



CONCLUSION

These findings demonstrate that acute exposure to environmental neurotoxins within the 9/11 World Trade Center dust cloud is significantly associated with long-term cognitive deficits. Furthermore, our results show complex, differentiated relationships between distinct cognitive domains and psychosocial factors. The finding that lower episodic memory correlates exclusively with the PHQ-9, while lower verbal fluency and t-MoCA scores link exclusively to the GDS, underscores how varied clinical profiles of depression interact uniquely with independent cognitive pathways. Conversely, the significant positive association between high social support and both verbal fluency and t-MoCA scores highlights that social support may mitigate the impact of environmental exposures and support cognitive resilience.

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