An Investigation into September 11th Related Post-Traumatic Stress Disorder and Anhedonic Depression

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Abstract

In addition to the social, political, and economic consequences, there have been many medical consequences of the September 11th disaster at the World Trade Center. Many of the medical side-effects were not initially present, especially those in regards to mental health. That is why it is so important to examine the development of anhedonia, as well as Post-Traumatic Stress Disorder, in those affected by the disaster. It was found that anhedonia was found to be present in a statistically significant 7.6% of the population, well above the national average. It is hoped that these results can be used by epidemiologists globally to aid with mental health-related disorders after traumatic events like those that took place on September 11th.

Introduction

Anhedonia, the loss of joy over time, has largely been thought of as a symptom of depressive and schizophrenic disorders rather than a disease of its own, but this attitude is rapidly changing (Franken et al., 2007; Nakonezny, 2010). Previous research has found substantial connections between anhedonia and other psychiatric and medical disorders such as emotional numbing, cognitive impairment, and the aging process (Clouston et al., 2016; Herrera-Pérez et al., 2008; Kashdan et al., 2006.). All of these aforementioned disorders have seriously psychologically debilitating symptomologies that make patients more susceptible to develop additional psychiatric disorders including anhedonia. Additionally, it has been shown that individuals with Post-Traumatic Stress Disorder (PTSD) are at an increased risk of developing anhedonia (Waszczuk et al., 2018). The purpose of this study is to examine the relationship between anhedonic depression (AD) and PTSD.

Populations with PTSD are extremely vulnerable to anhedonia due to their already increased rates of anxiety, depression, and stress along with many other comorbid disorders (Suliman et al., 2009; Hofmann et al., 2003). Additionally, increased incidence of substance abuse has been reported among populations with both anhedonia and PTSD. For example, both clinical populations have been shown to be more likely to be alcohol and nicotine dependent than a control population (Heinz et al., 1998; Stewart et al., 1998; Brown et al., 1995; Brown et al., 1998). This is explained by the common assertion that people with significant mental disorders, such as PTSD and anhedonia, often abuse addictive substances to cope with their emotional pain and distress (Brown et al., 1995; Heinz et al., 1998). This troubling tendency only further legitimizes why more research into the comorbidity of these disorders must be conducted in order to improve the general state of well-being for many among the American public.

First Responders to the September 11th disasters in New York City (NYC) were put in danger by many different physical and psychological factors (Webber et al., 2009). This is especially true for the civilian and non-traditional responder populations who had no prior experiences with disaster management or training of that sort, thus making research targeted to them ever the more important. The majority of research that has been conducted has been

through the three programs set up after the disaster to monitor individuals that may have had their health impacted by the disaster. The World Trade Center Health Program (WTCHP) was designed to be for police officers and "non-traditional" responders (those with no prior disaster management training such as construction workers). Also a separate program was made for firefighters, while anyone else who was directly impacted by the disasters was sent to the WTC Health Registry, which is monitored by the Department of Health. These programs investigate many different health issues alongside PTSD; post-traumatic stress symptoms were measured using the PTSD Checklist (PCL) in all three cases.

Hypothesis

Individuals with anhedonic depression will be at an increased risk of drastic changes to PTSD. These changes will also be clearly different by economic groups, with people closer/below the poverty line exhibiting greater changes and wealthier individuals having less apparent changes in regards to PTSD. In addition to income, there will be a strong correlation between PTSD changes due to anhedonic depression and education rates.

Methods

Setting

All data used was previously collected by Stony Brook University (SBU) WTCHP through self-report measures, clinical interviews, and physical examinations. All methods of data collection and the informed consent process were approved and monitored by the Institutional Review Board of Stony Brook University prior to investigation.

Participants

33,443 observations of data from over 8,000 participants were made available for inclusion in the study. Data was collected over the course of thirteen years, between 2004 and 2015. All participants were recruited from the World Trade Centre Health Program (WTCHP) clinical center at Stony Brook University and form the general responder's cohort. All observations contain data that was either self-reported or gathered through clinical interviews, as well as physical examinations and then compiled into the General Responders Cohort (GRC). Additionally, the vast majority of subjects were white non-Hispanic males with a high school education (Table 1). Participants were also asked to answer questions regarding basic demographic information including age, gender, income, marital status, and education levels as well as clinical information including the PCL, Exposure Assessment Questionnaire (EAQ), and the Patient Health Questionnaire (PHQ). All data used was received in a de-identified and anonymous fashion in order to maintain privacy standards.

PCL

As previously mentioned, all participants were asked to fill out the PCL-S (Specific Version), which is a test that measures PTSD symptom occurrence in the past month. The PCL is a very well-regarded test with a high internal validity (α=0.98) (Weathers et al., 1993). It has been used and verified in many studies of both clinical and nonclinical populations (Weathers et al., 1993; Wilkins et al., 2011). A cut-point score of 40 was used to determine probable PTSD among both traditional and non-traditional responders as recommended by the U.S. Department of Veterans Affairs (National Center for PTSD 2018). Only complete PCL scores were used in all data analysis.

PHQ

Although participants were asked to complete the PHQ-9 in its entirety, only the 2-item anhedonia subscale was analyzed. The PHQ-9 is a well-regarded instrument, but it lacks in the sense that it is designed to measure depression in a more general regard than anhedonia, which is the focus of the study. Therefore, analyzing a complete score yields inconclusive results when

testing for anhedonia. The subscale on the other hand specifically examines anhedonia presence over the past two weeks. Scores on this subscale range from 0 to 6 where anhedonia is determined as having a score of 3 or greater. Each of the two items are scored from 0-3 with 0 representing "not at all" and a score of 3 being "nearly every day" with an answer of 1 and 2 signifying "several days" and "more than half the days" respectively (Kroenke et al., 2003). Additionally, unlike the PHQ-9, its anhedonia subscale is widely accepted as a screening measure rather than a diagnostic tool.

EAQ

The EAQ was used to a lesser extent than the previously mentioned instruments. Questions from the EAQ pertain to dust exposure during the 9/11 disaster and subsequent events in addition to data regarding exposure to human remains and blood in the cleanup process during the months of September and October 2001. Two variables measured length of time in the dust cloud, one measured proximity to the dust cloud on 9/11/01 while in Lower Manhattan, and the last variable measured the exposure to human remains and/or blood. The questions pulled from the EAQ are asked in a dichotomous fashion with the only possible answers being "yes" or "no". These questions tend to have significantly lower rates of response than those in the other previously mentioned measures. This is likely due to the possibility of reexperiencing the traumatic events described in the EAQ and the subjects' reluctance to revealing such information.

SAS

SAS Software© version 9.3 was used to conduct all statistical analysis. SAS was chosen due to its well-proven abilities to handle large amounts of data and its design for medical and epidemiological data analysis. Analysis of Variance (ANOVA), Odds Ratios (OR), and several other specific statistical measures and descriptive measures were conducted using the program. All analysis conducted at α=0.05 (CL=95%) and a p-value of <0.05 was used for determining significance.

Results

Among the 27,414 observations, it was found that 6,541 (23.86%) tested positive for anhedonic depression and PTSD (Table 1). Additionally, the correlation between probable PTSD and anhedonia was determined by using binary logistic regression techniques as well as relative risk ratios (RR). Among the population affected by anhedonia , 61.20% (n=4003) also tested positive for concurrent PTSD ($p<0.0001$). The risk ratio was also determined to be 2.4454 (95%CI=2.3717-2.5213) for anhedonia among those affected with PTSD. Moreover, the model utilized for these tests received a concordance index of 0.805, indicating a strong model. The association between anhedonia and PTSD is best described by observing the difference in PCL-S mean scores and probable anhedonia; where those suffering from anhedonia have a least squares mean score of 45.25 ($p<0.001$) and observations that did not test positive for probable anhedonia had a least squares mean score of 23.24 ($p<0.001$) (Figure 1).

Speaking more specifically on PTSD, PCL-S scores among all observations ranged from 17-85 with a mean score of 28.49 (SD=13.88). As previously mentioned, a PCL-S score of 40 was used as a cut-off for determining probably PTSD, so it is important to note that those with anhedonia tested on average higher than that score. Furthermore, when race was investigated in terms of anhedonic depression, the results refuted the hypothesis by showing Caucasians and minorities to have very similar PHQ-2 scores, with the exception of Native Americans and Pacific Islanders who exhibited average scores of 1.09 and 0.23 respectively ($p=0.0367$). These findings were reached by conducting a one-way ANOVA. In addition to race, age at the time of the disaster was investigated as a possible covariate for increased rates of anhedonia. The age of a participant at the time of the disaster (09/11/2001) was found to directly significantly correlate with rates of anhedonia ($p=.0340$) when the model was adjusted to account for race and PTSD status.

Discussion

This study aimed to explore the relationship between anhedonic depression and PTSD among 27,414 clinical observations of world trade center responders. When examining anhedonia on its own, the aforementioned results were more alarming than expected due to the extremely high presence of anhedonia (23.86%). Although there is no current statistics available regarding rates of anhedonia in the general population, U.S. Department of Health and Human Services reports that only 5.4% of the general population suffers from any type of depressive disorder, let alone anhedonia in particular (Brody and Pratt 2008). It was hypothesized that our clinical population would have higher rates of psychiatric disorders than the general public, but the drastic difference between these two populations largely came as a disturbing surprise. Additionally, due to the strong correlations observed between PTSD and AD, it can be reasonably inferred that that the affected population will be more susceptible to additional serious psychiatric disorders, such as schizophrenia and bi-polar disorder. These high indecencies of serious mental disorders shows how serious of a public health issue 9/11 has been, as well as its lasting impact on the very large community which it has affected in the New York area.

Along the same lines, race was hypothesized as being a possible pre-determinate of anhedonia, but that hypothesis was not supported. The logic behind it was that it is traditionally believed that minority communities (African-American, Hispanic/Latino, and Asian) are less likely to report issues related to mental health than Caucasians (Broman, 2012). On the contrary, longitudinal results showed that minorities had comparable disorder progression to that of their Caucasian counterparts, with the exception of Asians, but results regarding their specific findings were determined to be statistically insignificant, largely due to a very small sample size (0.78% of the sample population). On the other hand, minorities were underrepresented in the sample with Caucasians comprising 83.82% of the sample even though only constituting 42.80% of the population of the New York City metropolitan area (U.S. Census Bureau).

These findings have the potential for a very wide reaching impact due to both the large sample size and the high rates of the investigated variables found amongst the aforementioned

population. As demonstrated by the sheer sample size, the events of September 11th had an impact, both direct and indirect, on many people in the immediate proximity of downtown Manhattan. With these drastically increased rates of PTSD and anhedonic depression, there is a possible public health crisis regarding mental health in the making. This shows how important it is that further research is conducted in regards to these disorders, mainly so that we can develop better screening processes to effectively treat these disorders as early as possible. With the eventual end goal being improved treatment, further investigation into the longitudinal trajectories of the disorders will be extremely useful to both the research community, as well as people who are affected by these disorders.

Appendix I

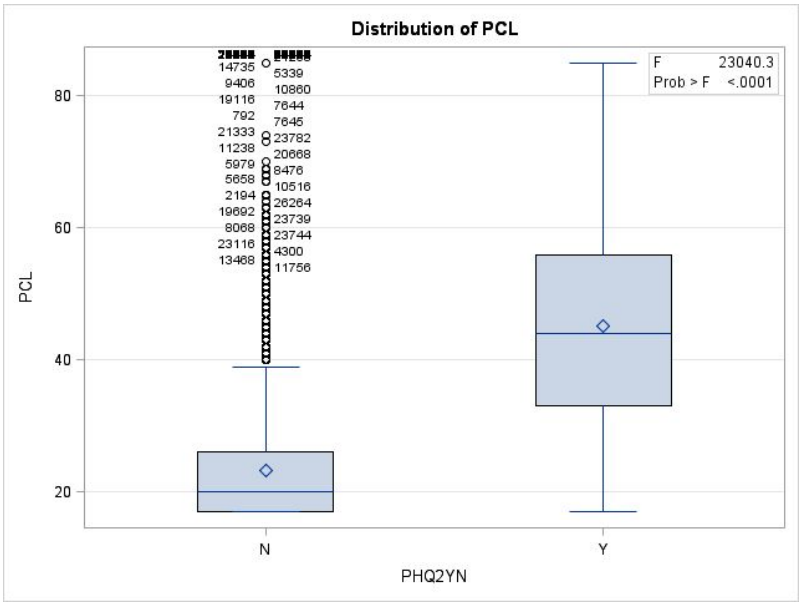
Table 1:

Table 1

Demographics

Variable	PTSD (n=5066)	No PTSD (n=22341)
Gender		
Male	4495 (16.50%)	20449 (74.61%)
Female	571 (2.08%)	1892 (6.09%)
Race		
White/Caucasian	4162 (15.19%)	18808 (68.62%)
Black/African-American	235 (0.86%)	960 (3.5%)
Asian	36 (0.13%)	179 (0.65%)
Other	542 (1.98%)	2394 (8.73%)
Anhedonia		
Present	4001 (14.6%)	2537 (9.26%)
Not Present	1065 (3.89%)	19804 (72.26%)

Figure 1:



Works Cited

Babor et al., (2001). *AUDIT: The Alcohol Use Disorders Identification Test Guidelines for Use in Primary Care (second Edition)*.

Broman, C. L. (2012). Race differences in the receipt of mental health services among young adults. *Psychological Services*, *9*(1), 38.

Bromet, E. J., Hobbs, M. J., Clouston, S. A. P., Gonzalez, A., Kotov, R., & Luft, B. J. (2016). DSM-IV post-traumatic stress disorder among World Trade Center responders 11–13 years after the disaster of 11 September 2001 (9/11). Psychological medicine, 46(4), 771-783.

Brown, P. J., Recupero, P. R., & Stout, R. (1995). PTSD substance abuse comorbidity and treatment utilization. *Addictive behaviors*, *20*(2), 251-254.

Brown, P. J., Stout, R. L., & Mueller, T. (1999). Substance use disorder and posttraumatic stress disorder comorbidity: Addiction and psychiatric treatment rates. *Psychology of Addictive Behaviors*, *13*(2), 115.

Clouston, S. A., Kotov, R., Piedra, R. H., Luft, B. J., Gonzalez, A., Richards, M., ... & Bromet, E. J. (2016). Cognitive impairment among World Trade Center responders: Long-term implications of re-experiencing the 9/11 terrorist attacks. *Alzheimer's & Dementia: Diagnosis, Assessment & Disease Monitoring*, *4*, 67-75.

Conner, K. O., Copeland, V. C., Grote, N. K., Koeske, G., Rosen, D., Reynolds III, C. F., & Brown, C. (2010). Mental health treatment seeking among older adults with depression: the impact of stigma and race. *The American Journal of Geriatric Psychiatry*, *18*(6), 531-543.

Franken, I. H., Rassin, E., & Muris, P. (2007). The assessment of anhedonia in clinical and non-clinical populations: further validation of the Snaith–Hamilton Pleasure Scale (SHAPS). Journal of affective disorders, 99(1-3), 83-89.

Heinz, A., Ragan, P., Jones, D. W., Hommer, D., Williams, W., Knable, M. B., ... & Coppola, R. (1998). Reduced central serotonin transporters in alcoholism. *American Journal of Psychiatry*, *155*(11), 1544-1549.

Herrera-Pérez, J. J., Martínez-Mota, L., & Fernández-Guasti, A. (2008). Aging increases the susceptibility to develop anhedonia in male rats. Progress in Neuro-Psychopharmacology and Biological Psychiatry, 32(8), 1798-1803.

Hofmann, S. G., Litz, B. T., & Weathers, F. W. (2003). Social anxiety, depression, and PTSD in Vietnam veterans. *Journal of Anxiety Disorders*, *17*(5), 573-582.

Kashdan, T. B., Elhai, J. D., & Frueh, B. C. (2006). Anhedonia and emotional numbing in combat veterans with PTSD. Behaviour research and therapy, 44(3), 457-467.

Kroenke, K., Spitzer, R., & Janet B. W. Williams. (2003). The Patient Health Questionnaire-2: Validity of a Two-Item Depression Screener. *Medical Care, 41*(11), 1284-1292.

Kroenke, K., & Spitzer, R. L. (2002). The PHQ-9: a new depression diagnostic and severity measure. *Psychiatric annals*, *32*(9), 509-515.

Lampe, I. K., Kahn, R. S., & Heeren, T. J. (2001). Apathy, anhedonia, and psychomotor retardation in elderly psychiatric patients and healthy elderly individuals. Journal of geriatric psychiatry and neurology, 14(1), 11-16.

National Center for PTSD. (2018, September 24). Retrieved from https://www.ptsd.va.gov/professional/assessment/adult-sr/ptsd-checklist.asp

Pratt, L. A., & Brody, D. J. (2008). Depression in the United States household population, 2005-2006.

Reinert, D. F., & Allen, J. P. (2002). The alcohol use disorders identification test (AUDIT): a review of recent research. *Alcoholism: Clinical and Experimental Research*, *26*(2), 272-279.

Suliman, S., Mkabile, S. G., Fincham, D. S., Ahmed, R., Stein, D. J., & Seedat, S. (2009). Cumulative effect of multiple trauma on symptoms of posttraumatic stress disorder, anxiety, and depression in adolescents. *Comprehensive psychiatry*, *50*(2), 121-127.

Turner, A. D., Capuano, A. W., Wilson, R. S., & Barnes, L. L. (2015). Depressive symptoms and cognitive decline in older African Americans: two scales and their factors. The American Journal of Geriatric Psychiatry, 23(6), 568-578

U.S. Census Bureau QuickFacts: New York city, New York. (n.d.). Retrieved from https://www.census.gov/quickfacts/newyorkcitynewyork

Vahia, Ipsit V., et al. "Subthreshold depression and successful aging in older women." The American Journal of Geriatric Psychiatry 18.3 (2010): 212-220.

Waszczuk, M. A., Li, K., Ruggero, C. J., Clouston, S. A., Luft, B. J., & Kotov, R. (2018). Maladaptive Personality Traits and 10-Year Course of Psychiatric and Medical Symptoms and Functional Impairment Following Trauma. Annals of Behavioral Medicine.

Webber, M. P., Gustave, J., Lee, R., Niles, J. K., Kelly, K., Cohen, H. W., & Prezant, D. J. (2009). Trends in respiratory symptoms of firefighters exposed to the World Trade Center disaster: 2001–2005. *Environmental health perspectives*, *117*(6), 975.

Wilkins, K. C., Lang, A. J., & Norman, S. B. (2011). Synthesis of the psychometric properties of the PTSD checklist (PCL) military, civilian, and specific versions. *Depression and anxiety*, *28*(7), 596-606.

Weathers, F. W., Litz, B. T., Herman, D. S., Huska, J. A., & Keane, T. M. (1993, October). The PTSD Checklist (PCL): Reliability, validity, and diagnostic utility. In *annual convention of the international society for traumatic stress studies, San Antonio, TX* (Vol. 462).