AMERICAN ACADEMY of HEALTH BEHAVIOR

Health Behavior Research

Volume 5 | Number 1 Article 3

February 2022

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Recommended Citation

Kauffman, Brooke Y.; Kotov, Roman; Garey, Lorra; Ruggero, Camilo J.; Luft, Benjamin J.; and Zvolensky, Michael J. (2022) "The Association Between Body Mass Index and Anxious Arousal, Depressive, and Insomnia Symptoms Among World Trade Center Responders," *Health Behavior Research*: Vol. 5: No. 1. https://doi.org/10.4148/2572-1836.1107

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Abstract

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Keywords

World Trade Center, Body Mass Index, Mental Health

Acknowledgements/Disclaimers/Disclosures

This work was supported by a pre-doctoral National Research Service Award awarded from the National Institute on Drug Abuse to Ms. Brooke Kauffman (F31-DA046127). The authors have no conflict of interest to declare, financial or otherwise.

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Abstract

Elevations in body mass index (BMI) among World Trade Center (WTC) responders may be associated with poor mental health outcomes. The current study examined the association of BMI with anxious arousal, depressive, and insomnia symptoms among this group. Participants were 412 WTC responders (89.4% male, M_{age} = 55.3 years, *SD* = 8.66) who completed health monitoring assessments (self-report and objective) as part of the Long Island site of the WTC Health Program (LI-WTC-HP). Results suggested BMI was statistically significant only in relation to anxious arousal ($sr^2 = .02$, $p = .008$), after accounting for age and sex. The current study suggests that weight management programs may aid in promoting additional benefits for WTC responders by reducing anxious arousal symptoms as a function of reduced BMI.

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Obesity rates continue to rise in the United States, with an estimated 42.4% of the adult population considered obese (Hales et al., 2020). Obesity rates among World Trade Center (WTC) responders (i.e., individuals who assisted with rescue, recovery, and/or clean-up efforts in response to the 09/11/2001 terrorists attacks on the WTC) are equally as high with cohort sample estimates as high as 42% (Aldrich et al., 2010; Icitovic et al., 2016; Skloot et al., 2009; Webber et al., 2011). Higher body mass index (a measure of overweight and obesity; [BMI]; USDHHS, 2020) among WTC responders may be due to a number of factors, including posttraumatic stress disorder (PTSD; Luft et al., 2012), low exercise frequency (Napier et al., 2017), and comorbid chronic diseases (Napier et al., 2017).

Elevations in BMI have been found to be associated with a number of psychiatric symptoms and disorders in past work (Avila et al., 2015). For example, research has found increasing gradations of BMI to be related to poor mental health outcomes (e.g., sleep quality, depression; Bjerkeset et al., 2008; Tepe et al., 2017). Among WTC responders, extant work, albeit limited, has examined the influence of BMI on adverse health outcomes (e.g., gastroesophageal reflux disease; Icitovic et al., 2016); however, relatively little is known about the impact it may have on anxious arousal, depressive, and insomnia symptoms among this population. This gap is unfortunate as mental health concerns are prevalent among WTC responders (Lucchini et al., 2012; CDC, 2021; Stellman et al., 2008), with factors such as long work shifts, fears related to safety, and exposure to human remains thought to contribute to such psychological distress (Bills et al., 2008). However, understanding additional factors that may maintain or contribute to psychiatric distress is warranted.

Among WTC responders, higher levels of BMI may be associated with greater mental health and sleep disturbance symptoms, such as anxious arousal, depressive, and insomnia symptoms. For example, higher levels of BMI may be associated with patho-physiological alterations (e.g., adipokines, inflammation) which, in turn, may contribute to poor mental health and insomnia (Taylor & MacQueen, 2010). Moreover, individuals with higher levels of BMI may experience weight-related stigma resulting in mal-adaptive coping strategies (e.g., avoidance, behavioral withdrawal, self-criticism; Myers & Rosen, 1999) and subsequent mental health symptoms and sleep disturbance (Emmer et al., 2019). Yet, to our knowledge, no study has examined the relations between BMI and anxious arousal, depressive, and insomnia symptoms among WTC responders to determine if these relations are present within this population.

The current study sought to examine the association between BMI and anxious arousal, depressive, and insomnia symptoms among WTC responders. It was hypothesized that higher levels of BMI would be associated with greater anxious arousal, depressive, and insomnia symptoms among a sample of WTC responders. We believed these relations would be evident over and above variance accounted for by age (Wada et al., 2015) and sex (McLean et al., 2011).

Methods

Participants

Participants in the current study included 414 traditional (e.g., police officers) and non-traditional (e.g., construction, maintenance, and transportation workers; electricians; clergy) WTC responders (89.4% male, M_{age} = 55.3 years, *SD* = 8.66) from the Long Island site of the WTC Health Program (LI-WTC-HP). The LI-WTC-HP is one of five medical institutions established by the Centers of Disease Control and Prevention to provide annual health monitoring and treatment to WTC responders (Herbert et al., 2006; Waszczuk et al., 2019). Exclusion criteria for the current study included: (1) Not being fluent in English (does not understand survey questions), (2) physical limitations that do not allow completion of study procedures, and (3) cognitive limitations that do not allow for completion of study protocols.

Most of the sample were law enforcement (67% police officers) and the remainder were non-traditional responders (e.g., construction, maintenance, and transportation workers; electricians; clergy; 33%). Approximately half of the sample (49%) reported working in the dust cloud on 9/11. The marital status of the current population was as followed: 75.8% married, 11.8% divorced, 6.5% single, 2.2% widowed, 1.2% remarried, 1.2% separated, and 1.2% cohabiting. The average BMI of the current sample was 31.46 (*SD* = 5.96).

Measures

Demographics. A demographic questionnaire was utilized to collect demographic information including age, sex, and marital status to describe the sample. Age and sex were utilized as covariates in the current study.

Dust cloud exposure. A dichotomous (yes/no) question was used to indicate whether a responder worked in the dust cloud on 9/11, which was the most consequential exposure in this population (i.e., greater risk for PTSD and respiratory problems; Luft et al., 2012). This variable was used to further describe the sample.

Body mass index. Height and weight was collected from participants objectively and used to calculate body mass index [weight (pounds)]/[height (inches)^2 x 703] using

World Health Organization (WHO Consultation on Obesity, 2000) recommendations. BMI was utilized as an independent variable in the current study.

Anxious arousal, depressive, and insomnia symptoms. The 99-item Inventory of Depression and Anxiety Symptoms, Expanded Version (IDAS-II) is a self-report measure used to assess diverse emotional symptomology (Watson et al., 2012). Participants were asked to rate on a 5-point Likert-type scale from 1 (*not at all*) to 5 (*extremely*) the degree to which they have experienced symptoms within the past two weeks. In the current study the: (1) anxious arousal scale ($\alpha = .84$), (2) general depression scale ($\alpha = .92$), and (2) insomnia scale ($\alpha = .89$) were utilized as criterion variables. The IDAS-II scales have demonstrated strong psychometric properties in past work (Watson et al., 2012; Watson et al., 2007).

Procedure

Data were collected from the first wave assessment of the WTC Health and Personality study (see Waszczuk et al., 2019). WTC responders from LI-WTC-HP who agreed to be contacted for research studies participated in the current study. WTC responders were approached by the study coordinator either (a) in person during a monitoring visit at the LI-WTC-HP clinic, or (b) by mail/phone shortly after their monitoring visit. Participants were scheduled for an appointment at the study site. Participants were provided informed consent prior to administration of any study procedures. Participants had the opportunity to be paid up to $150 for full participation in the first wave of the study. The study protocol was approved by the Institutional Review Board of Stony Brook University.

Analytic Strategy

Analyses were conducted in SPSS version 25.0. Descriptive statistics and zero-order correlations were examined among study variables. Then, three 2-step hierarchical regressions were conducted for three criterion variables: (1) anxious arousal symptoms, (2) depressive symptoms, and (3) insomnia symptoms. Step 1 of the model included study covariates of age and sex. Step 2 of the model included the addition of BMI. Model fit was evaluated for each step utilizing the F statistic and increase in variance accounted for (change in R^2). Measures of effect sizes of the individual predictors were measured utilizing squared semi-partial correlations (sr^2) and were interpreted as small (.01), moderate (.09), and large (.25; Cohen, 1988).

Results

Table 1 presents zero-order correlations among all study variables. BMI was statistically significant and positively associated with anxious arousal symptoms. There was not a statistically significant relationship between BMI and either depressive or insomnia symptoms. Regression results are presented in Table 2. In predicting anxious arousal symptoms, Step 1 of the model with study covariates only was not statistically significant. With the addition of BMI in step 2 of the model, the model emerged as statistically significant ($R^2 = .02$, $F(3, 410) = 2.73$, $p = .043$). The addition of BMI in the model accounted for a statistically significant increase in variance explained ($\Delta R^2 = .02$, $F(1, 410) = 7.109$, $p = .008$); BMI was a statistically significant predictor. For both depressive and insomnia symptoms, Step 1 of each model with covariates only was not statistically significant. Step 2 of the model with BMI added was also not statistically significant for depressive and insomnia symptoms.

Table 1

Descriptive Statistics and Correlations Between Study Variables (N = 414)

Variable	**Mean/n (SD/%)**	**1**	**2**	**3**	**4**	**5**	**6**
1. Age[a]	55.28 (8.66)	-					
2. Sex[a]	370 (89.4%)	.13**	-				
3. BMI[b]	31.46 (5.96)	-.06	.16**	-			
4. Anxious Arousal Symptoms[c]	11.37 (4.40)	.05	-.01	.12*	.-		
5. Depressive Symptoms[c]	38.50 (12.70)	-.02	.01	.09	.72***	-	
6. Insomnia Symptoms[c]	13.80 (5.89)	-.05	-.03	.05	.71***	.50***	-

Note. ***p* < .001, **p* < .05. [a]Covariate; [b]Independent variable; [c]Criterion; Sex: % listed as males (Coded: 0 = female and 1 = male); BMI = Body mass index; Anxious arousal symptoms = Inventory of Depression and Anxiety Symptoms II – Anxious Arousal scale (Watson et al., 2012); Depressive Symptoms = Inventory of Depression and Anxiety Symptoms II - General Depression scale (Watson et al., 2012); Insomnia Symptoms = Inventory of Depression and Anxiety Symptoms II – Insomnia scale (Watson et al., 2012).

Table 2

Hierarchical Regression Results

				Anxious Arousal Symptoms					
Model		*b*	*SE*	*β*	*t*	*p*	*CI (l)*	*CI (u)*	sr^2
1	Age	0.03	0.03	0.05	1.03	.305	-0.02	0.08	.00
	Sex	-0.19	0.71	-0.01	-0.27	.788	-1.58	1.20	.00
2	Age	0.03	0.03	0.06	1.26	.210	-0.02	0.08	.00
	Sex	-0.51	0.71	-0.04	-0.72	.474	-1.91	0.89	.00
	BMI	0.10	0.04	0.13	2.67	.008	0.03	0.17	.02
				Depressive Symptoms					
Model		*b*	*SE*	*β*	*t*	*p*	*CI (l)*	*CI (u)*	sr^2
1	Age	-0.04	0.07	-0.02	-0.50	.617	-0.18	0.11	.00
	Sex	0.72	2.05	0.02	0.35	.726	-3.30	4.74	.00
2	Age	-0.03	0.07	-0.02	-0.36	.722	-0.17	0.12	.00
	Sex	0.12	2.07	0.00	0.06	.953	-3.95	4.19	.00
	BMI	0.18	0.11	0.09	1.71	.088	-0.03	0.39	.01
				Insomnia Symptoms					
Model		*b*	*SE*	*β*	*t*	*p*	*CI (l)*	*CI (u)*	sr^2
1	Age	-0.03	0.03	-0.04	-0.87	.382	-0.10	0.04	.00
	Sex	-0.43	0.95	-0.02	-0.45	.651	-2.29	1.43	.00
2	Age	-0.03	0.03	-0.04	-0.78	.434	-0.09	0.04	.00
	Sex	-0.60	0.96	-0.03	-0.62	.534	-2.49	1.29	.00
	BMI	0.05	0.05	0.05	1.04	.298	-0.05	0.15	.00

Note. N for analyses is 414 cases Sex: Coded: 0 = female and 1 = male; BMI = Body Mass Index; Anxious Arousal Symptoms = Inventory of Depression and Anxiety Symptoms II – Anxious Arousal scale (Watson et al., 2012); Depressive Symptoms = Inventory of Depression and Anxiety Symptoms II - General Depression scale (Watson et al., 2012); Insomnia Symptoms = Inventory of Depression and Anxiety Symptoms II – Insomnia scale (Watson et al., 2012).

Discussion

The current study examined the relationship between BMI and mental health symptoms among WTC responders. As hypothesized, higher levels of BMI were associated with higher levels of anxious arousal symptoms. This finding was evident after accounting for theoretically relevant covariates, including age (Wada et al., 2015) and sex (McLean et al., 2011). However, the observed effect size was small (2% of unique variance). These data may suggest that weight management activities (e.g., exercise; Gaudlitz et al., 2015) could have an additive benefit of reducing anxious arousal symptoms among WTC responders through reductions in BMI. For example, through weight management programs (e.g., aerobic exercise), WTC responders may evidence a reduction in BMI which, in turn, may reduce potential fear/concerns of physical symptoms and sensations related to weight status (e.g., chest pain, shortness of breath). As a result, these individuals may experience reduced hypervigilance to their internal experiences, thereby reducing their anxious arousal.

Inconsistent with past work among other populations (Avila et al., 2015; Bjerkeset et al., 2008; Tepe et al., 2017) and our hypothesis, higher levels of BMI were not found to be statistically significant indicators of higher levels of depressive and insomnia symptoms. Thus, although extant work has found weight loss to be associated with improvements in depressive symptoms (Dixon et al., 2003; Firth et al., 2019) and sleep problems (Hudgel et al., 2018), this may not generalize to WTC responders. For example, WTC responders may experience weight-related symptoms (e.g., shortness of breath) associated with increased BMI which may be further exacerbated by pre-existing health conditions evidenced among this population (e.g., respiratory problems; Jordan et al., 2019). However, such symptoms may be more relevant in exacerbating anxiety-related symptoms (e.g., racing heart), rather than depressive or insomnia symptoms. However, future longitudinal studies are needed to fully clarify these relationships.

There are some limitations to the current study that warrant comment. First, the data used in the current study were cross-sectional and did not allow for temporal sequencing. Second, the sample consisted of majority male WTC responders employed as police officers. Future work may benefit from testing the observed relationships among a more diverse array of responders including a greater proportion of females. Finally, all measures, excluding height and weight, were collected via self-report. This method of collection may impose limitations including the possibility of shared method variance. Future work should include multi-method assessment approaches (e.g., actigraphy), to test the observed relations.

Overall, the present study provides initial evidence regarding the association between BMI and anxious arousal symptoms among WTC responders. These data highlight the need for continued research elucidating potential mental-physical health comorbidities in order to guide the development and testing of best practices when working with this vulnerable population. In order to enhance motivation for change, in addition to the physical health benefits, WTC responders should be informed of the potential additive benefit of engaging in weight management programs in reducing anxious arousal symptoms. Future research may benefit from examining additional covariates such as biological and social factors underlying these empirical observations.

Acknowledgments

This work was supported by a pre-doctoral National Research Service Award awarded from the National Institute on Drug Abuse to Ms. Brooke Kauffman (F31-DA046127). The authors have no conflict of interest to declare, financial or otherwise.

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