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The Association Between Body Mass Index and Gastroesophageal Reflux Disease in the World Trade Center Health Program General Responder Cohort

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Background *There is increasing concern about the obesity epidemic in the United States. Obesity is a potential risk factor for a number of chronic diseases, including gastroesophageal reflux disease (GERD). This analysis examined whether body mass index (BMI) was associated with physician-diagnosed GERD in World Trade Center (WTC) general responders.*

Methods *19,819 WTC general responders were included in the study. Cox proportional hazards regression models were used to compare time to GERD diagnosis among three BMI groups (normal ($<25\,kg/m^2$), overweight (≥ 25 and $<30\,kg/m^2$), and obese ($\geq 30\,kg/m^2$)).*

Results *Among the responders, 43% were overweight and 42% were obese. The hazard ratio for normal versus overweight was 0.81 (95% Confidence Interval (CI), 0.75–0.88); normal versus obese 0.71 (95%CI, 0.66, 0.77); and overweight versus obese 0.88 (95%CI, 0.83–0.92).*

Conclusion *GERD diagnoses rates were higher in overweight and obese WTC responders.* Am. J. Ind. Med. 59:761–766, 2016.

KEY WORDS: BMI; GERD; World Trade Center; 9/11

INTRODUCTION

Obesity and being overweight are growing epidemics, with prevalences in the United States (U.S.) population of 42% and 33%, respectively [NIDDK, 2012]. Obesity is a potential risk factor for a number of chronic diseases, including gastroesophageal reflux disease (GERD) [El-Serag et al., 2005; Hampel et al., 2005; Song et al., 2011; Almadi et al., 2014].

GERD is characterized by symptoms of heartburn, chest pain, and dysphagia, and has been associated with a poorer quality of life [Kaji et al., 2010; Milani et al., 2016]. Higher body mass index (BMI) has been associated with an increased risk of developing GERD. The most common physiological mechanism linking BMI to GERD involves

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an increased abdominal pressure that relaxes the lower esophageal sphincter, resulting in higher esophageal acid exposure [El-Serag et al., 2006; Pandolfino et al., 2006; Wu et al., 2007]. Other possible mechanisms by which obesity can cause GERD include an increase in the level of circulating inflammatory cytokines and delayed gastric motility [Emerenziani et al., 2013].

The World Trade Center Health Program (WTCHP) responders are a unique, occupational cohort, a large proportion of which suffered prolonged exposure to the physical contaminants and (physical and non-physical) stressors that accompanied work on the WTC recovery effort. These exposures potentially led to the development of GERD or may have modified the role of BMI in the development of GERD. Several studies have found an association between higher WTC exposure and GERD among firefighters, WTC responders, and survivors [Prezant et al., 2002; Li et al., 2011; Wisnivesky et al., 2011]. Furthermore, it has been observed that GERD persists among those responders who developed this condition after their WTC exposures [Prezant et al., 2002; Banauch et al., 2003; Wisnivesky et al., 2011]. GERD has been designated as a certified WTC condition and members of the WTCHP can receive medical treatment for GERD via the WTCHP [CDC, 2015]. To our knowledge, the overall prevalence of being overweight and obesity among the WTCHP members has not been previously reported. However, in a recent study of adults in the WTC Health Registry by Jordan et al. [2015], 43% were obese and 34% were overweight.

Given the potential links between elevated BMI and the development of GERD, the high prevalence and persistence of GERD among the responders and the potential modifiability of body size as a means of reducing the condition, we considered it important to examine the link between BMI and physician-diagnosed GERD in WTC responders.

METHODS

This study included 19,819 WTC general responders who are part of the WTCHP General Responder Cohort (GRC) and who consented to have their aggregated data used for research. The GRC has been described previously [Dasaro et al., 2015]. Included in the study were responders who participated in the monitoring program between July 2002 and December 2015, whose BMI was measured at their first visit and who had at least two BMI measurements during the monitoring program. IRB of the Icahn School of Medicine at Mount Sinai approved this investigation.

The WTCHP uses standard clinical practice guidelines for diagnosis of GERD [DeVault and Castell, 2005]. Certified GERD, the outcome in this analysis, requires attestation by a medical professional that exposures present during the WTC effort played a significant role in contributing to or causing a responder's GERD [Dasaro et al., 2015]. Final certification approval is done by the National Institute for Occupational Safety and Health. Only responders with certified GERD diagnosed after September 11, 2001 (hereafter 9/11) were included in the analysis. As diagnosis dates are self-reported on the Interviewer-Administered Medical Questionnaire (IAMQ), the dates are sometimes missing. Only responders certified with GERD who had a self-reported diagnosis date after 9/11 were included in the study; those with self-reported GERD but no certification were excluded. For those who reported diagnosis dates, imprecisely recalled dates (year only, or month, and year only) diagnosis dates were imputed to mid-year or mid-month (respectively). Of the 7,265 responders who reported a diagnosis date, 3,530 (49%) remembered only the year of diagnosis and 2,923 (40%) recalled the year and month.

BMI (weight in kg/(height in m)^2) was determined from height and weight measured as a part of the physical exam at each monitoring visit. For some responders, there were considerable inconsistencies in the measurement of height across visits. Major height changes in adults are uncommon and likely the result of measurement or data entry error. Therefore, in order to ensure that the calculated BMI was based on reliable height measurements, the weight measured at each visit and the median height (for responders with three or more visits) or visit 1 height (if the responder had fewer than three visits) were used to calculate BMI. For the 3,399 responders who had certified GERD diagnosed between 9/11 and before visit 1, their BMI at visit 1 was used.

As of December 31, 2015, there were 35,731 responders who had consented to have their aggregated data used for research and who had been seen for at least one WTC monitoring visit. Of these 35,731 responders, 9,835 (27.5%) were excluded because they did not have a BMI value at their first visit and/or did not have at least two BMI measurements; 4,093 (11.4%) were excluded because they had self-reported GERD but not certified GERD; 772 (2.2%) were excluded for having certified GERD diagnosed before 9/11; and 1,212 (3.4%) were excluded because of a missing diagnosis date (despite certified GERD). The final number of responders available for analysis was thus 19,819 (55.5%).

BMI associated with visit 1 was categorized into "normal" (BMI < 25), "overweight" ($25 \leq$ BMI < 30), and obese (BMI ≥ 30) [CDC, 2012]. The Kaplan–Meier method was used to obtain time to certified GERD diagnoses rates 3, 7, and 14 years post 9/11. A Cox proportional hazards regression model compared time to certified GERD diagnosis between the three BMI groups. The model was adjusted for year of entry into the program (2002–2005, 2006–2008, after 2008), WTC exposure (very high, high, intermediate, and low), pre-9/11 occupation ("protective services" [e.g., law enforcement], "construction," "buildings and grounds cleaning and maintenance," "electrical,

telecommunications, and other installation and repair groups," and "all other" occupations), age on 9/11, gender (male, female), race/ethnicity (Asian Non-Hispanic, Black [Hispanic and Non-Hispanic], Hispanic [not Black], Other Non-Hispanic, White Non-Hispanic), marital status (married/partnered, separated/divorced/widowed, single), education (less than high school graduate, high school graduate, some college, college graduate), and smoking status (current, former, never). Barrett's esophagus disease is known to be correlated to GERD but in our population only those who are certified for GERD can be certified for Barrett's disease. We could not, therefore, include Barrett's disease as a covariate since all patients certified for Barrett's disease are certified for GERD as well.

Statistical tests were two-sided; comparisons were evaluated for statistical significance at the $P = 0.05$ level; and all statistical analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC).

RESULTS

The characteristics of the study population are shown in Table I. Of the 19,819 eligible responders, 86% were male and 64% reported their race/ethnicity as non-Hispanic White. Three quarters of the responders entered the program before 2008 and they were, on average, 39 years of age on 9/11. A large proportion reported that they were married or partnered (72%); less than half had attended some college (41%); and more than half had never smoked (62%). The most common occupations were protective services (51%) and construction (21%). Most were overweight or obese (85%) and 37% were certified for GERD (Table I). Of the responders with normal weight, 33% had certified GERD, compared to 36% of overweight responders and 39% of those who were obese. Kaplan–Meier time to diagnoses rates were 10% in year 3, 24% in year 7, and 35% in year 14 for responders with normal weight; 12% in year 3, 26% in year 7, and 39% in year 14 for overweight responders and 14% in year 3, 27% in year 7, and 42% in year 14 for obese responders. The unadjusted hazard ratios were 0.88 (95%CI, 0.82–0.95) for normal compared to overweight; 0.80 (95%CI, 0.75–0.86) for normal compared to obese; and 0.91 (95%CI, 0.87–0.96) for overweight compared to obese (Table II). Adjusting the Cox model for covariates made hazard ratios even more significant: 0.81 (95%CI, 0.75–0.88) for normal compared to overweight; 0.71 (95%CI, 0.66–0.77) for normal compared to obese; and 0.88 (95%CI, 0.83–0.92) for overweight compared to obese (Table II). WTC exposure was included in the model as one of the covariates. WTC exposure is associated with GERD (P-value <0.001) with risk of GERD being higher with higher WTC exposure; however, GERD is independent of BMI (P-value $= 0.4119$ for BMI and exposure interaction term).

TABLE I. Visit 1 Characteristics of World Trade Center General Responders (2002–2015)

Number of responders[a]—n	19,819
Male sex—n (%)	17,070 (86)
Average age in years on 9/11—mean ± SD	38.7 ± 8.7
BMI at visit 1—n (%) kg/m^2	
<25	2,881 (15)
25–29	8,547 (43)
≥30	8,391 (42)
Have certified GERD[b]—n (%)	7,265 (37)
Year of entry into the program—n (%)	
2002–2005	8,505 (43)
2006–2008	6,050 (30)
>2008	5264 (27)
Race—n (%)	
White Non-Hispanic	12,687 (64)
Black (Hispanic and Non-Hispanic)	2,287 (12)
Asian Non-Hispanic	320 (2)
Hispanic (not black)	4,222 (21)
Other Non-Hispanic	282 (1)
Not known/declined to be categorized	21 (0)
Smoking status at baseline visit—n (%)	
Current	2,643 (13)
Former	4,757 (24)
Never	11,836 (60)
Not known	583 (3)
Education—n (%)	
<High school graduate	1,457 (7)
High school graduate	4,195 (21)
Some college	7,869 (40)
College graduate	5,641 (29)
Not known	657 (3)
Marital status—n (%)	
Single	2,265 (11)
Married or partnered	14,187 (72)
Separated or divorced or widowed	3,337 (17)
Not known	30 (0)
WTC-related exposure [c]—n (%)	
Low	2,857 (14)
Intermediate	12,145 (61)
High	3,471 (18)
Very high	634 (3)
Not known	712 (4)
Occupation—n (%)	
Construction	4,065 (21)
Protective services	9,978 (50)
Building and grounds cleaning/maintenance and installation, maintenance, and repair	1,757 (9)
Other categories or missing	4,019 (20)

[a]World Trade Center (WTC) general responders who are part of the WTC Health Program (WTCHP) General Responder Cohort who participated in the monitoring program between July 2002 and December 2015, whose body mass index (BMI)

was measured at their first visit, who had at least two BMI measurements during monitoring program, who either had no self-reported nor certified gastroesophageal reflux disease (GERD) or who had GERD certified post 9/11.

[b]Certification requires attestation by a medical professional that exposures present during the WTC effort played a significant role in contributing to or causing a responder's GERD.

[c]The very high exposure group consisted of those who worked more than 90 days, were exposed to the dust cloud, and worked at least some time on the pile. The high group was comprised of rescue workers who were exposed to the dust cloud but either worked less than 90 days or did not work on the pile. The intermediate group was comprised of workers not exposed to the dust cloud and who either worked 40 or more days or worked on the pile. The lowest exposure group included those who worked less than 40 days, were not exposed to dust from the collapse, and did not work in the debris pile.

DISCUSSION

"Normal" weight responders were at reduced risk of being diagnosed with GERD, compared to both overweight and obese responders. Furthermore, being overweight was associated with a reduced risk of being diagnosed with GERD, compared to being obese. Although the prevalence of being overweight (per BMI) was higher among these responders than has been observed for the general US population—43% vs. 33%—the prevalence of obesity was similar at 42% [NIDDK, 2012]. Moreover, the rates of GERD in all three responder body size groups were higher than the 20% prevalence in the US population [NIDDK, 2014]. There are little data on population level obesity/overweight specifically among blue-collar workers. Approximately 60% of European professional drivers and constructions workers were overweight or obese, which is lower than the prevalence observed among the WTC responders [Arndt et al., 2007; Rosso et al., 2015]. The prevalence among the WTC responders and a U.S. population of firefighters was similar [Clark et al., 2002]. To our knowledge, there have not been any reports of the prevalence of GERD in blue-collar populations.

Our data agree that GERD is associated with WTC exposure as previously suggested in WTC firefighters where 87% of FDNY workers diagnosed with WTC cough reported having GERD in the first 6 months after 9/11/2001 [Prezant et al., 2002], responders where risk of GERD was greatest in workers with the highest level of WTC exposure [Wisnivesky et al., 2011] and survivors where area workers exposed to the intense dust cloud had an increased risk of developing gastroesophageal reflux symptoms [Li et al., 2011]. However, our data showed that GERD is independent of BMI and therefore does not modify the role of BMI in the development of GERD, as hypothesized. There was a small confounding effect so models were adjusted for WTC exposure but the effect on BMI was minimal.

This investigation has both weakness and strengths. The most important weakness is that most health information (including diagnosis dates, most of which had to be imputed) is self-reported. This is less than optimal but not likely to result in differential misclassification. It is possible that the use of BMI may not be the optimal indicator of obesity or overweight in this population. For example, in a population of U.S. firefighters, it has been shown that compared to the waist circumference and body-fat percentage measures BMI overestimates prevalence of obesity and being overweight [Jitnarin et al., 2013, 2014; Choi et al., 2016]. A large proportion of the responders included in this analysis were in protective services and construction workers (Table I), and the body composition of people in these occupations are likely to be similar to the firefighters. Therefore, it is possible that some responders were misclassified as being overweight or obese. Waist circumference or body-fat percentage measures are not collected as part of the WTC monitoring visit. Another limitation is that health information prior to 9/11 is not available for the general responders and participation in the WTCHP is voluntary, making it difficult to assess how representative this cohort is of all WTC responders [Dasaro et al., 2015]. The principal strength is that this is a large cohort that has been followed for more than 14 years with periodic health monitoring visits.

The health outcome, GERD, is physician-diagnosed and has been shown to be a WTC-related condition that is persistent and affects a large proportion of the WTC responder population. It is, therefore, in our opinion, of great importance to increase our understanding of the contribution that obesity—a potentially modifiable risk factor—makes in the development of GERD. The results of this analysis indicate that WTC responders who are overweight or obese might reduce their risk of developing

TABLE II. Association Between Body Size Categories Among WTC Responders With GERD (2002–2015)

BMI	Unadjusted hazard ratio (95%CI)	Adjusted hazard ratio (95%CI)
Normal versus obese	0.80 (0.75–0.86)	0.71 (0.66–0.77)
Normal versus overweight	0.88 (0.82–0.95)	0.81 (0.75–0.88)
Overweight versus obese	0.91 (0.87–0.96)	0.88 (0.83–0.92)

The "Normal" BMI group consisted of 2,881 responders, 933 of whom had certified GERD diagnosed post 9/11. The "Overweight" BMI group consisted of 8,547 responders, 3,068 of whom had certified GERD diagnosed post 9/11. The "Obese" BMI group consisted of 8,391 responders, 3,264 of whom had certified GERD diagnosed post 9/11. The model was adjusted for year of entry into the program, WTC exposure, pre-9/11 occupation, age on 9/11, gender, race/ethnicity, marital status, education and smoking status.

GERD via weight reduction programs. Participation in preventive programs such as weight reduction has the potential to improve the overall quality of life of the responders, in addition to reducing the medical care that responders might require.

AUTHORS' CONTRIBUTIONS

Icitovic, Shapiro, and Teitelbaum provided input on study conception and design. Icitovic, Wallenstein, Jiang, Kaplan, Pendem, Shapiro, Todd, and Teitelbaum contributed to data acquisition, analysis, and interpretation. Icitovic, Onyebeke, Todd, and Teitelbaum contributed to the drafting of manuscript. All authors contributed to the critical revision of intellectual content. All authors provided final manuscript approval and agree to be accountable for all aspects of the work in order to ensure that all questions related to the accuracy and integrity of any part of the work are appropriately investigated and resolved.

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INSTITUTION AND ETHICS APPROVAL AND INFORMED CONSENT

The World Trade Center Health Programs were initially approved by the Institutional Review Board of The Mount Sinai School of Medicine, and subsequently by both the IRB of the Icahn School of Medicine at Mount Sinai and IRBs of the clinical sites listed in the author affiliations. The Health Programs obtained the signed consent of all participants. All procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

DISCLOSURE (AUTHORS)

The authors report no conflicts of interest.

DISCLOSURE BY AJIM EDITOR OF RECORD

Steven Markowitz declares that he has no competing or conflicts of interest in the review and publication decisionregarding this article.

DISCLAIMER

None.

REFERENCES

Almadi MA, Almousa MA, Althwainy AF, Altamimi AM, Alamoudi HO, Alshamrani HS, Alharbi OR, Azzam NA, Sadaf N, Aljebreen AM. 2014. Prevalence of symptoms of gastroesophageal reflux in a cohort of Saudi Arabians: A study of 1265 subjects. Saudi J Gastroenterol 20(4):248–254.

Arndt V, Rothenbacher D, Zschenderlein B, Schuberth S, Brenner H. 2007. Body mass index and premature mortality in physically heavily working men—A ten-year follow-up of 20,000 construction workers. JOEM 49(8):913–921.

Banauch GI, Alleyne D, Sanchez R, Olender K, Cohen HW, Weiden M, Kelly KJ, Prezant DJ. 2003. Persistent hyperreactivity and reactive airway dysfunction in firefighters at the World Trade Center. Am J Respir Crit Care Med 168:54–62.

Centers for Disease Control and Prevention (CDC). 2012. Defining Adult Overweight and Obesity. http://www.cdc.gov/obesity/adult/defining.html. Accessed April 21, 2016.

Centers for Disease Control and Prevention (CDC). 2015. WTC Health Program: Covered Conditions. http://www.cdc.gov/wtc/conditions.html. Accessed April 26, 2016.

Choi B, Steiss D, Garcia-Rivas J, Kojaku S, Schnall P, Dobson M, Baker D. 2016. Comparison of body mass index with waist circumference and skinfold-based percent body fat in firefighters: Adiposity classification and associations with cardiovascular disease risk factors. Int Arch Occup Environ Health 89:435–448.

Clark S, Rene A, Theurer WM, Marshall M. 2002. Association of body mass index and health status in firefighters. JOEM 44(10):940–946.

Dasaro CR, Holden WL, Berman KD, Crane MA, Kaplan JR, Lucchini RG, Luft BJ, Moline JM, Teitelbaum SL, Tirunagari US, et al. 2015. Cohort profile: World trade center health program general responder cohort. Int J Epidemiol DOI: 10.1093/ije/dyv099

DeVault KR, Castell DO. 2005. Updated guidelines for the diagnosis and treatment of gastroesophageal reflux disease. Am J Gastroenterol 100:1243–1250.

El-Serag HB, Graham DY, Satia JA, Rabeneck L. 2005. Obesity is an independent risk factor for GERD symptoms and erosive esophagitis. Am J Gastroenterol 100:1243–1250.

El-Serag HB, Tran T, Richardson P, Ergun G. 2006. Anthropometric correlates of intragastric pressure. Scand J Gastroenterol 41: 887–891.

Emerenziani S, Rescio MP, Guarino MPL, Cicala M. 2013. Gastro-esophageal reflux disease and obesity, where is the link? World J Gastroenterol 19(39):6536–6539.

Hampel H, Abraham NS, El-Serag HB. 2005. Meta-analysis: Obesity and the risk for gastroesophageal reflux disease and its complications. Ann Intern Med 143:199–211.

Jordan HT, Stellman SD, Reibman J, Farfel MR, Brackbill RM, Friedman SM, Li J, Cone JE. 2015. Factors associated with poor control of 9/11-related asthma 10-11 years after the World Trade Center terrorist attacks. J Asthma 52(6):630–637.

Jitnarin N, Poston WSC, Haddock CK, Jahnke S, Tuley BC. 2013. Accuracy of body mass index-defined overweight in firefighters. Occup Med 63:227–230.

Jitnarin N, Poston WSC, Haddock CK, Jahnke S, Day RS. 2014. Accuracy of body mass index-defined obesity status in US firefighters. Saf Health Work 5:161–164.

Kaji M, Fujiwara Y, Shiba M, Kohata Y, Yamagani H, Tanigawa T, Watanabe K, Watanabe T, Tominaga K, Arakawa T. 2010. Prevalence of overlaps between GERD, FD, and IBS and impact on health-related quality of life. J Gastroenterol Hepatol 25:1151–1156.

Li J, Brackbill RM, Stellman SD, Farfel MR, Miller-Archie SA, Friedman S, Walker DJ, Thorpe LE, Cone J. 2011. Gastroesophageal reflux symptoms and comorbid asthma and posttraumatic stress disorder following the 9/11 terrorist attacks on World Trade Center in New York City. Am J Gastroenterol 106:1933–1941.

Milani DC, Venturini APC, Callegari-Jacques SM, Fornari F. 2016. Gastro-oesophageal reflux disease and dental erosions in adults: Influence of acidified food intake and impact on quality of life. Eur J Gastroenterol Hepatol 28(7):797–801.

National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). 2012. Overweight and Obesity Statistics. http://www.niddk.nih.gov/health-information/health-statistics/Pages/overweight-obesity-statistics.aspx. Accessed April 18, 2016.

National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). 2014. Definition and Facts for GER and GERD. http://www.niddk.nih.gov/health-information/health-topics/digestive-diseases/ger-and-gerd-in-adults/Pages/definition-facts.aspx. Accessed April 18, 2016.

Pandolfino JE, El-Serag HB, Zhang Q, Shah N, Ghosh SK, Kahrilas PJ. 2006. Obesity: A challenge to esophagogastric junction integrity. Gastroenterology 130:639–649.

Prezant DJ, Weiden M, Banauch GI, McGuiness G, Rom WN, Aldrich TK, Kelly KJ. 2002. Cough and bronchial responsiveness in firefighters at the World Trade Center site. NEJM 347(11):806–815.

Rosso GL, Perotto M, Feola M, Bruno G, Caramella M. 2015. Investigating obesity among professional drivers: The high risk professional driver study. AJIM 58:212–219.

Song JH, Chung SJ, Lee JH, Kim Y, Chang DK, Son HJ, Kim JJ, Rhee JC, Rhee P. 2011. Relationship between gastroesophageal reflux symptoms and dietary factors in Korea. J Neurogastroenterol Motil 17(1):54–60.

Wisnivesky JP, Teitelbaum SL, Todd AC, Boffetta P, Crane M, Crowley L, De La Hoz RE, Dellenbaugh C, Harrison D, Herbert R, et al. 2011. Persistence of multiple illnesses in World Trade Center rescue and recovery workers: A cohort study. Lancet 378:888–897.

Wu JC, Mui L, Cheung CM, Chan Y, Sung JJ. 2007. Obesity is associated with increased transient lower esophageal sphincter relaxation. Gastroenterology 132:883–889.