Epidemiology of Obesity Mortality in the United States 1999-2016

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ABSTRACT

Background: The prevalence of obesity in the U.S. has been increasing drastically since the declaration of the obesity epidemic in 2001. This study investigated the epidemiology of obesity mortality in the U.S.

Methods: Using CDC WONDER, obesity mortality was explored using ICD-10 code E66.

Results: The national age-adjusted obesity morality rate for 2016 was 2.1 deaths per 100,000. Obesity mortality rates were highest among individuals age 35 and older, males, Blacks, and those living in nonmetro areas.

Discussion: Poverty may be a factor for the disparities found in Blacks and those living in nonmetro areas. These findings provide relevant information that can guide public health resource allocation. Additionally, we recommend adding obesity as a required section on the death certificate.

INTRODUCTION

Despite the Call to Action issued by the Surgeon General in 2001 to address the obesity epidemic, the prevalence of obesity in the United States has continued to increase drastically over the last few decades from 12.0% in 1991 to 42.4% in 2018.[1–3] Obesity is defined as a body mass index (BMI) of 30 or higher; a normal BMI ranges from 18.5 to less than 25.[4] Since 1960, the incidence of obesity has more than doubled in the United States, with 42.4% of the adult population categorized as being obese.[3]

Obesity has many negative consequences relating to health. It is a risk factor for many chronic diseases including cardiovascular disease, diabetes, psychological disorders, cancer, and physical mobility.[5] In 2008 alone, obesity-related costs resulted in an estimated $147 billion in medical spending.[6] Additionally, obesity severely impacts quality of life and is associated with diabetes and its complications.[5] Much is known about obesity prevalence in the United States from national surveys like the Behavioral Risk Factor Surveillance System (BRFSS) and the National Health and Nutrition Assessment Survey (NHANES). Data from 2000 demonstrated that obesity is the second leading cause of death in the United States and is projected to become the first leading cause of death.[2] However, there is a need to better describe the epidemiology of obesity mortality. Understanding obesity mortality as it relates to time, person, and place is important information that can be used to determine who is most affected and where to allocate public health resources to resolve this epidemic. This descriptive epidemiologic study explores obesity mortality in the United States using data from CDC WONDER.

METHODS

The epidemiology of obesity mortality (ICD-10 code E66) in the U.S. was investigated with a descriptive study by using the CDC WONDER database. CDC WONDER is published by the U.S. Department of Health and Human Services, Center for Disease Control and Prevention, National Center for Health Statistics, and the Office of Analysis and Epidemiology.[7] The database contains information from the U.S. records of deaths for years 1968 – 2016; however, as only data filed under ICD-10 codes was utilized in the descriptive study, data was only analyzed for the years 1999 – 2016.[7] Participants included all individuals included in the "Compressed Mortality File 1999-2016 Series 20 No. 2U, 2016", which contains information about mortality and population counts for all U.S. counties. To address potential confounders, mortality was stratified by multiple factors including race, age, gender, urbanization, state, and year. Rates that were suppressed due to too few numbers of deaths were excluded from the analysis. Rates were age-adjusted to the 2000 U.S. population using CDC WONDER. Excel was used for data analysis and figure creation; data files available upon request. CDC WONDER was utilized to calculate 95% confidence intervals.

After the initial component of the study was completed to obtain comprehensive data regarding epidemiologic factors affecting obesity mortality, outcomes were analyzed to gauge which exposures and predictors should be further investigated to fully characterize the epidemiology. Specifically, any disparities or interesting trends that were identified in the initial outcomes were further investigated with supplementary data analysis and additional stratification. A major goal

of this analysis was to determine what exposures and predictors influenced the outcomes observed. The literature was consulted throughout the descriptive study to look for additional evidence that supported or contradicted the results obtained from CDC WONDER. The literature review was also utilized to identify important trends or disparities that warranted further investigation.

RESULTS

As the CDC WONDER database includes information from all U.S. death certificates, it provides an accurate representation of mortality rates for the United States population across all demographic categories. Stratifying the data by multiple factors revealed descriptive information on exposure and confounders related to obesity. Stratifying by multiple factors occasionally resulted in unreliable and suppressed data, which is further described below.

Table 1 shows age-adjusted mortality rates in 2016 stratified by one factor at a time (age, gender, race, urbanization, year). The 2016 national age-adjusted obesity mortality rate was 2.1 deaths per 100,000 (Table 1). Individuals age 35 and older have a mortality rate 13 times higher than individuals younger than 35 (Table 1). When stratifying by gender (male and female), it was found that males have an obesity age-adjusted mortality rate of 2.3 deaths per 100,000, which is significantly higher rate than the female rate of 2.0 deaths per 100,000 (Table 1). Race was stratified by the following categories: White, Black, American Indian/Alaska Native, and Asian/Pacific Islander. Blacks were found to have the highest age-adjusted obesity mortality rate

at 3.4 deaths per 100,000 which is significantly higher than the other three racial groups (Table 1). Asian/Pacific Islanders had the lowest mortality rate at 0.3 deaths per 100,000 (Table 1).

The "place" data revealed that as urbanization decreases, obesity mortality increases. Urbanization data was stratified according to 2013 Urbanization Classification under Metro (Large Central Metro, Large Fringe Metro, Medium Metro, and Small Metro) and Nonmetro (Micropolitan and Noncore). Individuals who live in nonmetro areas had a significantly higher mortality rate at 2.8 deaths per 100,000 compared to those who live in metro areas at 2.0 deaths per 100,000 (Table 1, Figure 1). The obesity mortality rate by state had no clear trend or pattern. Vermont had the highest rate at 5.1 deaths per 100,000 followed by West Virginia, New Mexico, and New Hampshire at 4.1 deaths per 100,000 (data available upon request). Hawaii had the lower rate at 1.1 deaths per 100,000 followed by Nevada at 1.5 deaths per 100,000 and Alabama and Massachusetts at 1.6 deaths per 100,000 (data available upon request). Stratifying by age, race, and urbanization at the state level resulted in unreliable and suppressed data.

From 1999 to 2016, there was a significant increase of 133% in the obesity age-adjusted mortality rate from 0.9 deaths per 100,000 to 2.1 deaths per 100,000 (Figure 2). Blacks had a significantly higher mortality rate than the overall rate and the White rate every year between 1999-2016 (Figure 2).

Stratification was limited by multiple factors to only Blacks and Whites; when stratifying Asia/Pacific Islanders and American Indian/Alaskan Native by age and urbanization, the data became unreliable and suppressed. Stratifying by multiple factors revealed that in Blacks age 35

and older living in non-metro areas experienced the highest age-adjusted rate of mortality at 8.2 deaths per 100,000 which is nearly 4 times higher than the national rate (Figure 1). Both Blacks and Whites age 35 and older living in nonmetro areas had higher rates of mortality than their same age counterparts living in metro areas (Figure 1). Individuals of all races and locations under age 35 had significantly lower mortality rates compared to individuals age 35 and older (Table 1).

DISCUSSION

This study most notably demonstrates that all races are affected by obesity mortality, but Blacks experience the highest mortality rate and have had the sharpest rate increase since 1999 (Table 1, Figure 1, Figure 2). This study also revealed a clear disparity by urbanization; individuals living in rural areas have higher rates of obesity compared to individuals living in urban areas (Table 1, Figure 1). Additionally, there is a distinctive trend for time as the data demonstrated a 133% increase in the age-adjusted mortality rate from 1999 to 2016 (Table 1, Figure 2).

Our findings regarding obesity mortality rates were consistent with the trends obtained from the literature regarding obesity prevalence rates, although the reported obesity mortality rates were consistently lower than the obesity prevalence rates.[3] In the National Center for Health Statistics' (NCHS) February 2020 report, it stated that nearly 48% of Blacks are obese, which is the highest of all races.[3] In this same report, NCHS also described rising rates since 1999 that were consistent with the information obtained from CDC WONDER.[8] The Morbidity and Mortality Weekly Report published an article, using data from the 2016 Behavioral Risk Factor

Surveillance System (BRFSS), that stated individuals in nonmetropolitan areas have higher rates of obesity compared to individuals living in metropolitan areas.[9] The literature also stated that individuals living in poverty are more likely to be obese. Although socioeconomic status information was not available from CDC WONDER, this information is consistent with our findings as there is a higher percentage of Blacks living in poverty than there are Whites.[10] The literature discussed poverty as being the primary upstream factor to account for both disparities observed related to race and urbanization. Individuals living in poverty are more likely to experience food deserts.[11–13] Food deserts disproportionately affect poor neighborhoods and neighborhood that are predominately Black.[14,15] Being in a food desert limits access to affordable, healthy food options and promotes unhealthy options like fast food restaurants. As such, food deserts may explain the obesity rate disparity seen among Blacks and the disparities seen in urbanization.

The advantage of using the CDC WONDER database is that it compiles data from the entire nation into one central database. From there, the data can be sorted and stratified by many different factors. This helps in finding disparities between very specific groups, like the significant difference in the age-adjusted obesity mortality rate between White females living in large fringe metro areas (2.8 deaths per 100,000) and Black females living in micropolitan areas (9.5 deaths per 100,000) (Figure 1).

One major limitation of this study is the absence of a standardized method for filling out death certificates. A physician, nurse practitioner, or coroner determines the cause of death and it is up to his or her discretion on what to include for the underlying causes of death. For example, an obese patient who dies from a heart attack may not have obesity listed as the underlying cause of death on their death certificate even though it was likely a significant contributor. In addition, a

patient doesn't necessarily have to be obese to have the E66 code. The patient could be overweight (BMI between 25 and 30) but still have the cause of death listed as obesity.

These findings provide information relevant for future public health program and policy planning. For the younger population, programs offered in K-12 schools to promote prevention of obesity would be most appropriate as obesity and its related diseases can be prevented in most cases through healthy lifestyle choices. For the older population, programs and policies focused on the management of disease would help those who have developed obesity and its related diseases. Proper management of diseases, like diabetes and hypertension, and promoting healthier lifestyles would reduce the risk of dying from obesity and obesity-related complications.[5] These findings demonstrate that additional resources should be dedicated to Black communities in nonmetropolitan areas. This could be achieved in several ways, such as increasing access to primary care providers, increasing awareness of health insurance assistance, providing incentives for grocery stores to build in rural areas, and subsidizing the cost of healthy foods for low-income individuals. Importantly, the lack of consistent policies regarding death certificate completion in addition to the discrepancy observed between obesity rates and obesity mortality rates indicates the need for standardizing completion requirements for death certificates. It would be feasible to require height and weight information to be included on death certificates in order to calculate BMI data for all deaths in the United States. Although this information is readily available in patients' medical charts, it's important that the information is directly included on death certificates in order to ensure this information is entered into databases. Currently, death certificates require an answer to the question, "Did tobacco use contribute to death?". Many would argue that obesity is the new smoking; it is pertinent that

accurate data is collected about obesity mortality to demonstrate the devastating implications of obesity.

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Table 1: Trends in Obesity Mortality by gender, race, age, urbanization, and time in the United States, 2016. Rates are age-adjusted to the 2000 U.S. population.

	Total No. of Deaths	Age-adjusted Mortality Rate per 100,000 (95% CI)	Relative Risk
Total	**7727**	**2.1 (2.1, 2.2)**	**-**
Gender			
Men	3979	2.3 (2.2, 2.4)	1.00 (ref.)
Women	3748	2.0 (1.9, 2.0)	0.87
Race			
White	6108	2.1 (2.0, 2.1)	1.00 (ref.)
Black	1463	3.4 (3.2, 3.6)	1.62
American Indian/Alaska Native	87	2.2 (1.7, 2.7)	1.05
Asian/Pacific Islander	69	0.3 (0.3, 0.4)	0.14
Age group			
<35	471	0.3 (0.3, 0.3)	1.00 (ref.)
35+	7256	3.9 (3.8, 4.0)	13
Place - Urbanization			
Metro	**6183**	**2.0 (2.0, 2.1)**	**-**
Large Central Metro	2036	1.9 (1.8, 2)	1.00 (ref.)
Large Fringe Metro	1559	1.7 (1.6, 1.8)	0.89
Medium Metro	1740	2.3 (2.2, 2.4)	1.21
Small Metro	848	2.6 (2.4, 2.8)	1.37
Nonmetro	**1544**	**2.8 (2.7, 3.0)**	**-**
Micropolitan (Nonmetro)	884	2.8 (2.6, 3.0)	1.47
Noncore (Nonmetro)	660	2.8 (2.6, 3.0)	1.47
Time			
1999	2599	0.9 (0.9, 1.0)	1.00 (ref.)
2000	2989	1.1 (1.0, 1.1)	1.22
2001	3139	1.1 (1.1, 1.1)	1.22
2002	3690	1.3 (1.2, 1.3)	1.44
2003	4021	1.4 (1.3, 1.4)	1.56
2004	4203	1.4 (1.4, 1.4)	1.56
2005	4649	1.5 (1.5, 1.6)	1.67
2006	4746	1.5 (1.5, 1.6)	1.67
2007	4848	1.5 (1.5, 1.6)	1.67
2008	5027	1.6 (1.5, 1.6)	1.78
2009	5429	1.7 (1.6, 1.7)	1.89
2010	5542	1.7 (1.6, 1.7)	1.89
2011	5962	1.8 (1.7, 1.8)	2.00
2012	6190	1.8 (1.8, 1.8)	2.00
2013	6452	1.9 (1.8, 1.9)	2.11
2014	6890	2.0 (1.9, 2.0)	2.22
2015	7430	2.1 (2.0, 2.1)	2.33
2016	7727	2.1 (2.1, 2.2)	2.33

Figure 1. Trends in obesity mortality by age, race, and urbanization in the United States, 2016. Rates are age-adjusted to the 2000 U.S. population. Error bars represent 95% confidence intervals.

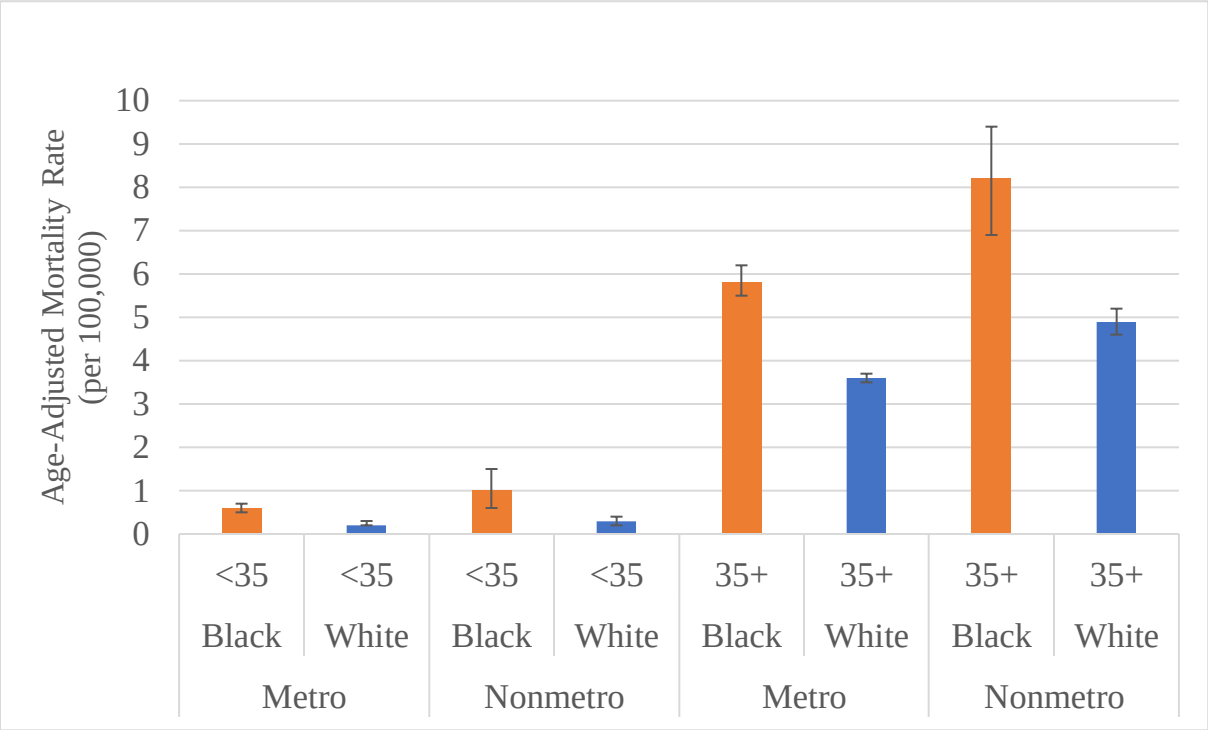

Figure 2. Trends in Obesity Mortality over time in the United States, 1999-2016. Rates are age-adjusted to the 2000 U.S. population. Error bars represent 95% confidence intervals.