Extended abstract
The contribution of weight status to black-white differences in mortality and life expectancy

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Introduction

Black-white (B-W) mortality differences in the United States are sizable and persistent, posing a significant and longstanding public health concern. The B-W gap in life expectancy at birth has fluctuated over time, and varies by state (Harper et al. 2014). Despite its recent narrowing, the gap remains large. In 2010, the non-Hispanic black male life expectancy at birth (71.4) was 5.0 years lower than that of non-Hispanic white males (76.4). The respective gap for women was 3.4 years (77.7 [blacks] and 81.1 years [whites]). At age 50, to which 89-93% non-Hispanic black and white men and 93-96% of non-Hispanic black and white women survive, the gap remained sizable at 3.4 years for men and 2.2 years for women (Arias 2014).

In 2008, mortality from cardiovascular diseases and diabetes together accounted for 38% of the B-W life expectancy gap at birth among men and 54% among women (Harper et al. 2012). Two well-known risk factors contribute to mortality from these causes, namely smoking and obesity. Ho and Elo (2013) investigated the contribution of smoking to B-W differences in mortality above age 50 and found that smoking accounted for 20% to 48% of the difference between 1980 and 2005 among men, but smoking did not contribute to B-W difference in mortality among women. Several studies have examined the contribution of obesity to mortality among whites and African Americans (Abell et al 2008; Cohen et al. 2012), but these studies have not explicitly assessed the contribution of obesity to B-W differences in mortality.

Several studies have documented higher prevalence of obesity among blacks than whites in the United States. For example, based on the 2007-2008 National Health and Nutrition Examination Survey (NHANES) using measured height and weight Flegal et al. (2010) estimated the prevalence of age-standardized obesity (BMI ≥ 30) above age 20 to be 49.6% among non-Hispanic black women compared to 33.0% among non-Hispanic white women; the difference among men was more modest with the respective figures being 37.3% versus 31.9%. Non-Hispanics black men and women also had higher prevalence of grade 2 (BMI ≥ 35) and grade 3 (BMI ≥ 40) obesity than did non-Hispanic whites (Flegal et al. 2010). Blacks are also disproportionately affected by diabetes. African Americans at ages 20 and above are more than twice as likely to have diagnosed or undiagnosed diabetes and they are more likely to be hospitalized for diabetes-related diseases (Centers for Disease Control 2014; Chow et al. 2012; Elvin et al. 2014). Given the higher prevalence of obesity among black than white Americans, there is reason to suspect that the B-W difference in the prevalence of obesity could play a role, not only in the B-W difference in mortality, but also in the B-W difference in morbidity, e.g., cardiovascular events and diabetes for which obesity is an important risk factor (Abdullah et al. 2011, 2014; Tarleton et al. 2014). We expect the role of obesity in B-W differences in morbidity and mortality to be much larger for women than for men.

B-W Differences in the Association of Obesity with Mortality and Health: While ample evidence indicates that obesity increases death and disease risk, there is conflicting evidence as to whether obesity has an equally damaging effect for blacks and whites. Earlier studies that have examined the contribution of obesity to mortality among blacks and whites have concluded that the association appears to be more pronounced for whites than blacks, especially among women (e.g., Abell et al. 2008; Cohen et al. 2012; Jackson et al. 2014; Xiao et al. 2014; Zheng and Yang 2012). Other recent studies, however, suggest that the attenuated relationship between BMI and mortality is observed only among overweight but not obese black women (Patel et al. 2014; Park et al. 2012), while still other studies show risks similar to those observed for white women (Boggs et al. 2011). Furthermore, a recent pooled analysis of BMI and mortality among African Americans concluded: “Obesity was associated with a higher risk of mortality [relative to normal weight] in African
Americans, similar to that observed in pooled analyses of whites and East Asians. This study provides compelling evidence to support public health efforts to prevent excess weight gain and obesity in African Americans” (Cohen et al. 2014: Abstract; see also Park et al. 2012). Possible reasons for inconsistent findings in prior studies are small sample sizes, short duration of follow-up, samples that are more representative of low income individuals (some studies have suggested a possible interaction between BMI and educational attainment and income among blacks), and confounding by smoking and pre-existing morbidity (Ibid; Boggs et al 2011; Cohen et al. 2012).

The Importance of Obesity Histories: In the above studies, BMI was measured at baseline, the beginning of mortality follow-up, yet recent research points to the importance of assessing BMI at earlier ages and times. Using both baseline and retrospective information on height and weight collected in the NHANES, Preston et al. (2013) found that BMI at age 25 and BMI at age 40 (or 10 years prior to the surveys) were statistically significant predictors of mortality even in the presence of controls for BMI at the time of survey. Similarly, Park et al. (2012) concluded that overweight in young adulthood conferred excess risk of mortality in later life, and that this association appeared to be stronger than the association between overweight measured at an older age in a multiethnic cohort of individuals living in California and Hawaii. Furthermore, other recent research finds that what seems to be particularly important is the highest BMI attained, “peak BMI,” regardless at what age it occurs. For example, Mehta et al. (2014), using data from Finland, found that the excess risk of mortality associated with peak BMI was double the risk of obesity measured at baseline, at the start of the mortality follow-up. Similarly, using recent NHANES data, Stokes (2014) found that among non-smokers age 50-84 the number of deaths attributable to BMI ≥ 25.0 was 33% when it was calculated based on peak BMI compared to only 5% when calculated based on BMI at the time of the survey.

The key strength of measuring BMI at an early age, including peak BMI, is that these measures are likely to be more robust to reverse causation compared to BMI measured at time of survey. The earlier assessments of BMI are less likely to be influenced by weight loss due to disease. In addition, models using estimates of the duration of obesity based on Framingham life cycle data have been shown to outperform models based on baseline obesity in predicting the onset of diabetes (Abdullah et al. 2011) and cardiovascular disease (Abdullah et al. 2014). These measures are yet to be applied systematically to examine the contribution of obesity to B-W differences in mortality or morbidity. Thus, further insights can be gained regarding the contribution of obesity to B-W differences in mortality and morbidity by using these alternative measures of BMI. Our preliminary tabulations of “ever obese” prevalence based on NHANES 1999-2004 among blacks and whites at ages 50-74 are consistent with this expectation. They show large variation on the prevalence of ever having been obese between non-Hispanic black (61.8%) and non-Hispanic white (37.8%) women; the percentages for men were similar 47.8% among non-Hispanic black men versus 47.1% among non-Hispanic white men (tabulations by the authors).

Purpose of the present study

In this paper, we will extend prior research on the contribution of obesity to B-W differences in mortality in several ways. First, we will introduce more nuanced measures of BMI that have been shown to better predict the excess risk of mortality in prior studies. These measures have not been previously used to examine the contribution of weight status to B-W differences in mortality. We will provide separate estimates for men and women. These measures include BMI at an early age (e.g., age 25), obesity duration, and peak BMI. Second, we will compare these estimates to the more traditional estimates of baseline BMI measured at the time of mortality follow-up. Third, we will calculate population attributable risk fractions (PAFs) due to obesity by race and gender from the various ways of modeling the association between BMI and mortality (Rockhill et al. 1998; Stokes 2014). Fourth, we will estimate the contribution of weight status to life expectancy at age 40 by race and sex and how these contributions vary depending on the measure of weight status used (Preston and Stokes 2011).

Data and Methods

To assess the contribution of weight status to black-white difference in mortality we will use data from the NHANES I (1971-1974), II (1976-1980), III (1988-1994) and 1999-10 waves. These surveys are linked to subsequent death records contained in the National Death Index (NDI) through 2011. We will restrict the
samples to native-born non-Hispanic whites and non-Hispanic blacks to avoid confounding by nativity. The general procedure that we will employ involves first estimating hazard ratios of death for the various BMI measures and then applying these hazard ratios to estimate the proportion of mortality that is attributable to obesity for blacks and whites. A comparison of B-W differences in mortality before and after removing deaths attributable to obesity will show the role of obesity to B-W differences in mortality. Analyses will be conducted at ages 40-74.

We will use Cox proportional hazard models with age as the underlying time scale to estimate hazard ratios. Smoking status is a potentially important confounder or moderator of the obesity-health relationship. We will explore models that are stratified by smoking status or otherwise include interaction terms between smoking and obesity (Cohen et al. 2014; Orpana et al. 2010; Stokes 2014). NHANES collects information on weight at age 25 and age 40 and respondents were also asked about the most they have ever weighed, excluding weight during pregnancy. BMI at the time of the survey can be calculated from measured height and weight. We will code the various measures of BMI following prior studies (Cohen et al. 2014; Preston et al. 2013; Mehta et al. 2014, Stokes 2014). All models will include sociodemographic variables such as age, marital status, educational attainment, and income. We will test whether the association between various measures of BMI and mortality varies by race by introducing an interaction term between race and these BMI measures. We will also allow the hazard ratios to vary by age. All estimates will be made separately for men and women.

We will use the hazard ratios to calculate population attributable risk fractions (PAF) due to weight status by race. We will use the method recommended for calculating PAFs with a multi-category exposure variable in the presence of confounding (Rockhill et al. 1998):

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PAF = \sum_{i=0}^{k} pd_i \left( \frac{RR_i - 1}{RR_i} \right) = 1 - \sum_{i=0}^{k} \frac{pd_i}{RR_i}
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where \( i \) refers to BMI category, and \( pd_i \) is the fraction of the total deaths occurring in the \( i^{th} \) weight status category. \( RR_i \) is the hazard ratio for the \( i^{th} \) obesity category. The PAF estimates the proportion of deaths that could be avoided if all overweight and obese people were redistributed to the optimal weight status category. These PAF estimates will be used to estimate the contribution of obesity to B-W differences in life expectancy at age 40 using methods outlined in Preston and Stokes (2013). Using cause-specific death data, we will further calculate the proportion of black and white deaths from CVD attributable to obesity.

References


