# EDITORIAL

# Obesity, Overweight, Hypertension, and High Blood Cholesterol: The Importance of Age

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Of late, there has been increased interest among epidemiologists in issues of data sharing, partly due to new legal requirements (1,2). Published analyses of data from the National Health and Nutrition Examination Surveys (NHANES) provide examples of possible issues that can arise. These data are made publicly available, there are no restrictions on their use for epidemiologic analyses, and there is no central coordination of analyses.

In the current issue of *Obesity Research*, Brown et al. (3) provide an extensive analysis of NHANES III data on body mass index (BMI), blood pressure, and blood lipids. An article published last year by Must et al. (4) analyzed the same NHANES III data for these and other health conditions. These two articles have several methodological differences. For example, Brown et al. (3) analyzed data for ages 20 years and older, whereas Must et al. (4) restricted their analyses to data for ages 25 years and older. Brown et al. (3) used definitions for hypertension and high blood cholesterol based on physiological or laboratory measurements and on reported pharmaceutical treatment. Must et al. (4) used broader definitions for these conditions and thus got higher prevalence estimates. The BMI categories used are different. Brown et al. (3) used four categories of BMI, with cutoff points at values of 25, 27, and 30; each of the resultant groupings included at least 10% of the population, generally more. Must et al. (4) used six categories, with cutoff points at values of 18.5, 25, 30, 35, and 40. Three of these six categories, the lowest and the two highest, included only a very small proportion of the population ($<5\%$ of the population, and sometimes $<1\%$). In addition, the statistical methods used in the two studies differ slightly.

Although the findings in the two studies are broadly similar, there are some notable differences. Brown et al. (3) found statistically significant interactions between race/ethnic group and BMI categories as predictors of hypertension and high blood cholesterol. In contrast, Must et al. (4) found no significant interaction between race/ethnic group and BMI categories. Brown et al. (3) found significant linear associations between high blood cholesterol and BMI category; Must et al. (4) did not. These differences between the two analyses could be due to slight differences in the analytic sample, to differences in the definition of the outcomes, to differences in the construction of BMI categories, or to differences in the statistical methods used.

The emphasis in both studies on BMI as a risk factor draws attention away from some aspects of the association of hypertension and high blood cholesterol with age. Both studies found a significant interaction of age with BMI category. Both showed that at older ages, the prevalence or odds ratio for various outcomes associated with higher BMIs is lower than at younger ages. Because of this interaction, Must et al. (4) presented results stratified by age ($<55$ years; $\geq 55$ years). Brown et al. (3) also found an interaction of age and BMI but rather than stratifying by age, they included age, BMI category, and the interaction in their models. The more extensive quantitative data on age effects provided by Brown et al. (3) allow the reader a better look at some interesting implications of these effects.

The data presented in the article by Brown et al. (3) suggest, somewhat surprisingly, that despite the statistically significant association of BMI with hypertension and high blood cholesterol, reduction of overweight and obesity might not have a large impact on the population prevalence of hypertension and high blood cholesterol. In the multivariate models presented by Brown et al. (3) an age of $\geq 60$ years is the strongest risk factor for hypertension and high blood cholesterol in both men and women, even after adjusting for BMI category. For hypertension, an age of $\geq 60$ is associated with a multivariate odds ratio of 25.7 for men and 88.4 for women.

According to the analyses by Brown et al., (3) the prevalence of hypertension is low at younger ages (9% among men aged 20 to 39 years) and high at older ages (52% for men aged 60 to 79 years). At older ages, the prevalence is high even in normal-weight individuals (BMI $<25$). Among men aged 60 to 79 years with BMI values $<25$, the prevalence of hypertension is 50%. This suggests that if the

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entire group of older men had BMI values <25, the prevalence of hypertension for that age group might be only a few percentage points lower. Because the preponderance of cases of hypertension occur in the older age groups, even a considerable reduction in the prevalence of overweight and obesity, as defined by BMI, might not necessarily lead to a large change in the population prevalence of hypertension.

Similarly, the data for high blood cholesterol presented by Brown et al. (3) show the overall prevalence as 25% for men aged 60 to 79 and the prevalence for men in this age group with BMI <25 as 22%, again suggesting that if all men in this age group had BMI values <25, the prevalence of high blood cholesterol might be only a few percentage points lower. The results are generally similar for women for hypertension; however, for high blood cholesterol for women, the differences are greater between BMI categories at older ages. The prevalence of low levels of high-density lipoprotein cholesterol, in contrast, increases little with age, and BMI category is a more important contributing factor than age for this outcome.

As shown in both articles, age is strongly associated with hypertension and high blood cholesterol and strongly associated with higher prevalences of overweight and obesity. Thus, age will generally be a confounding factor in analyses of hypertension and high blood cholesterol. Part of the difference among BMI categories in the prevalence of these conditions is related to age, rather than to weight itself. A descriptive analysis of the prevalence of these conditions by BMI category, without controlling for age, such as that presented by Must et al. (4) in their Table 3, may exaggerate the excess risk associated with BMI categories. Brown et al. (3) in their Figure 2, present age-adjusted values that may more accurately reflect these relationships.

These data suggest that although overweight and obesity are important contributors to these two cardiovascular risk factors, they are not necessarily the main influences. Indeed, the models presented by Brown et al. (3) explain on average <10% of the variance of these risk factors among men and 18% among women. As pointed out by Brown et al. (3), the NHANES data have shown decreases over time in both hypertension and high blood cholesterol, despite the increases in overweight and obesity over the same period. This reinforces the message of the National Heart, Lung, and Blood Institute clinical guidelines (5): that treatment of cardiovascular risk factors is important in itself.

The conclusions of the two studies differ slightly in emphasis. Must et al. (4) emphasize the prevention and treatment of obesity, whereas Brown et al. (3) also emphasize measurement and control of blood pressure and cholesterol. According to Must et al. (4), "The prevalence of obesity-related comorbidities emphasizes the need for concerted efforts to prevent and treat obesity rather than just its associated comorbidities." Brown et al. (3) conclude that, "[these data] are consistent with the national emphasis on prevention and control of overweight and obesity and indicate that blood pressure and cholesterol measurement and control are especially important for overweight and obese people." Both sets of conclusions focus on the role of BMI as a contributor to these cardiovascular risk factors, tending to neglect the high levels of hypertension and high blood cholesterol present at older ages regardless of BMI level. The results presented by Brown et al. (3) suggest that although control of overweight and obesity could play a role in reducing hypertension and high blood cholesterol, the prevalence of these conditions might remain high. Additional efforts would be necessary to control hypertension and high blood cholesterol.

The contrasts in findings and conclusions between these two articles, both of which analyzed the same data set, clearly show some issues that can arise when data are made publicly available. The availability of multiple independent analyses of the same data set may lead to uncertainties when the results or conclusions from the same data set differ, as they do in these two articles. However, this can also be a strength because it allows us to see an issue from diverse points of view; only rarely will two independent groups choose precisely the same analytic strategies and reach exactly the same conclusions.

## References


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