

Long-term Obesity and Physical Functioning in Older Americans

Jennifer Beam Dowd, PhD,^{1,2} and Anna Zajacova, PhD³

¹Epidemiology and Biostatistics, CUNY School of Public Health, Hunter College, City University of New York (CUNY), New York, NY

²CUNY Institute for Demographic Research (CIDR), New York, NY

³Department of Sociology, University of Wyoming, Laramie, WY

Abstract (150 words):

Many Americans are becoming obese earlier in their lives, increasing the average number of years lived with obesity. The implications of long-term obesity will be important for anticipating functioning and disability trends among aging cohorts and forecasting the corresponding morbidity and economic burdens to individuals and society. Despite the importance of understanding these associations, the impact of long-term obesity on physical functioning of older adults is not well known. This paper will examine the association of long-term obesity and physical functioning using data from 7,487 adults aged 60-79 from the U.S. 1999-2010 National Health and Nutrition Examination Survey (NHANES). Using retrospective data on reported weight at age 25 and current BMI, we will test the impact of long-term obesity on multiple indicators of physical limitation. The results will help inform medical and policy planning for the aging of cohorts who have come of age during the obesity epidemic.

Introduction

The aging of populations across the world has brought physical functioning and disability among the elderly to the forefront of public health and medical priorities. As obesity rates have risen in the U.S. over the past several decades, so too has the average duration of obesity over an individual's lifetime. In 2009-2010, 35.9% of American adults aged 20 and older were categorized as obese compared to 13.3% in 1960-1962 (1, 2) and the probability of being obese at age 25 has increased by 30% for those born between 1955 and 1975 (3). The trend toward increasing lifelong obesity in recent cohorts has been projected to decrease life expectancy and increase disability rates in the U.S (2, 3).

The physiological impact of duration of obesity on functioning and disability has not been well established. If the duration of exposure to obesity impacts disability analogously to the cumulative risks of pack-years of smoking (4), the implications for population aging and the medical costs of the large numbers of U.S. children and young adults who are currently obese could be dramatic (5).

Current obesity has been shown to predict functional decline and disability in older adults (6-9). The effect of obesity may operate through several mechanisms. Obesity can hinder mobility directly due to the weight-bearing burden on lower extremities during activities such as climbing stairs or rising from a seated position, and longer-term obesity may increase wear and tear on musculoskeletal system and connective tissues (10). Obesity has been associated with a variety of musculoskeletal conditions including osteoarthritis, low back pain, gait disturbance, soft tissue conditions such as plantar fasciitis, and gout (10). Obesity also increases the risk of cardiovascular

disease and diabetes, both of which are important risk factors for disablement (11, 12). Insulin resistance in particular has been shown to be an independent predictor of poor muscle strength (13, 14), and diabetes predicts loss of muscle strength and quality. Adipose tissue is also associated with increased expression of inflammatory cytokines such as IL-6 and TNF- α (15, 16), and long-term obesity may inhibit regulatory responses resulting in a systemic pro-inflammatory state. Chronically elevated levels of inflammatory markers are strong predictors of incident disability, partly via acceleration of muscle catabolism (17-19).

Despite these potential links, few studies have explicitly examined the health effects of long-term obesity, and none to our knowledge have focused on physical functioning and disability. The current study will analyze the association of obesity at age 25 with self-reported activity limitations later in adulthood in a nationally representative U.S. sample of adults aged 60-79. We hypothesize that longer exposure to obesity could exacerbate the pro-inflammatory and insulin resistance impacts on muscle strength over time, as well as directly impact wear and tear on connective tissues and joints, resulting in more physical limitations and disability.

METHODS

Data

Data come from the National Health and Nutrition Examination Survey 1999-2010, a representative survey of the non-institutionalized U.S. population (20). The continuous NHANES surveys conducted by the National Center for Health Statistics collect extensive demographic and health data, including detailed information on physical

limitations, through a household interview and a separate medical examination.

Additional details of the NHANES survey design have been published elsewhere (21).

Analytic Sample

Our sample is defined as adults aged 60-79 who participated in the medical examination (N=7,487).

Measures

Predictors

BMI at age 25 and current BMI. The NHANES interview component included a weight history questionnaire asking, “How much did you weigh at age 25?” Recalled weight has been found to have a high correlation with measured weight across long recall periods (22, 23). Current height and weight were measured by a trained technician during the medical examination, and current and BMI at age 25 were calculated as $BMI = \text{weight(kg)/height (m)}^2$, both using current height. BMI at age 25 was then categorized according to CDC guidelines (<18.5=underweight, 18.5-24.9=normal, 25.0-29.9=overweight, >=30=obese); current BMI was included in models as continuous measure.

Outcomes

We will analyze individual as well as summary measures of physical limitations. Respondents will be considered functionally limited in a particular domain if they reported difficulty or much difficulty with the particular task including: walking one-fourth mile, walking up 10 steps without resting, stooping/crouching/kneeling, lifting or carrying 10 lb, walking between rooms on the same floor, standing from an armchair,

getting in and out of bed, dressing oneself, and standing for long periods. A summary measure of the number of limitations will also be analyzed.

Covariates/Effect Modifiers

All models will control for age in years, race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, and “Other”), education (less than high school, high school completion, some college, or completed college or higher), and smoking status (current, former, or never). We will also test whether the impact of long-term obesity on disability varies by socioeconomic status including level of education and household income.

Statistical Analysis

We will test how long-term obesity and current level of obesity jointly influence the physical functioning of older adults. We will use logistic regression models to predict the relative odds of risk for each functional limitation as a function of BMI at 25, current BMI, and control variables. Model 1 will include only BMI at 25 and adjust for socio-demographic covariates, while Model 2 will additionally control for current BMI (continuous) to account for the more severe obesity among those obese at age 25 and currently obese. All models will be estimated separately for males and females, conducted using STATA 13.0, and adjusted for the NHANES complex survey design.

DISCUSSION

The health implications of long-term obesity are of increasing medical and public health importance. Disability among older adults can lead to loss of independence and the need for expensive hospital and long-term nursing care (24, 25). To our knowledge, no

previous papers have examined the association between duration of obesity and physical functioning. Our findings will help inform projections of the impact of the obesity epidemic on the prospects for disability among aging U.S. cohorts who have lived a higher proportion of their lives obese compared to previous cohorts.

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