The Impact of Obesity on Active Life Expectancy in Older American Men and Women

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Purpose: The purpose of this article is to estimate the effect of obesity on both the length of life and length of non-disabled life for older Americans. Design and Methods: Using data from the first 3 waves of the Asset and Health Dynamics Among the Oldest Old (AHEAD) survey, this article develops estimates of total, active, and disabled life expectancy for obese and non-obese older men and women. We used the Interpolation of Markov Chains (IMaCh) method to estimate the average number of years obese and non-obese older persons can expect to live with and without activity of daily living (ADL) disability. Results: Our findings indicate that obesity has little effect on life expectancy in adults aged 70 years and older. However, the obese are more likely to become disabled. This means that obese older adults live both more years and a higher proportion of their remaining lives disabled. Implications: The lack of significant differences in life expectancy by obesity status among the old suggests that obesity-related death is less of a concern than disability in this age range. Given steady increases in obesity among Americans at all ages, future disability rates may be higher than anticipated among older U.S. adults. In order to reduce disability among future cohorts of older adults, more research is needed on the causes and treatment of obesity and evaluations done on interventions to accomplish and maintain weight loss.

In the past two decades, the problem of increasing levels of obesity in the United States has become a major public health concern, with more than 25% of adults currently obese and nearly half overweight (Flegal, Carroll, Kuczmarski, & Johnson, 1998; Mokdad et al., 1999). At the population level, some researchers have found that the prevalence of obesity peaks in middle age (Ferraro, Thorpe, & Wilkinson, 2003). At the individual level, some have found that individual levels of body mass index (BMI) tend to increase in middle age while decreasing in late life (Cornoni-Huntley et al., 1991). Regardless of prevalence, the effects of obesity on health have been shown to persist well into later life (Himes, 2000).

The literature on obesity and mortality suggests that the effect of obesity on mortality declines at older ages (Bender, Jöckel, Trautner, Spraul, & Berger, 1999; Lindsted & Singh, 1997; Thorpe & Ferraro, 2004). At the same time, the literature on obesity, disease, and disability suggests that obese older adults have higher rates of disability (Freedman & Martin, 1999; Jenkins, 2004).

Most researchers have focused on the impact of obesity on mortality, or on the presence or onset of diseases and disability, but few have considered them together. The aim of this article is to summarize the effect of obesity on life expectancy and healthy life expectancy for older American men and women. Examination of active life expectancy, defined as life free of difficulty in performing six activities of daily living (ADLs), provides insight into the question of how health changes in old age among those who are obese and non-obese translate into years lived with life of different quality.
Background

Obesity and Old-Age Mortality

Many researchers have found a positive relationship between obesity and mortality—increased obesity led to higher mortality (Calle, Thun, Petrelli, Rodriguez, & Heath, 1999; Kenchaiah et al., 2002; Peeters et al., 2003). Increasingly, however, evidence has emerged to suggest that the relationship may differ by age. Some researchers have found lower death rates among the obese at older ages (Bender et al., 1999; Lindsted & Singh, 1997). Others have found that obesity lessens life expectancy more for younger adults than for older adults (Fontaine, Redden, Wang, Westfall, & Allison, 2003; Thorpe & Ferraro, 2004). The implication is that obesity may not have as large an impact on old-age mortality as it does on younger and middle-aged adults (Ferraro et al., 2003).

Obesity and Disability

There is some evidence of a link between obesity and decreases in functioning in older adults. Studies have shown a deleterious effect of obesity on upper and lower body functioning (Apovian, et al., 2002; Jenkins, 2004) and in mobility limitations (Davison, Ford, Cogswell, & Dietz, 2002). In addition, other researchers have found evidence of a negative impact of obesity on ADL and instrumental ADL (IADL) functioning (Coakley et al., 1998; Freedman & Martin, 1999; Jenkins, 2004).

Active Life Expectancy

Active life expectancy is often operationalized as the amount, or percent, of remaining life the average person of a given age can expect to live without disability. Studies have regularly estimated active life expectancy for the old population based on ability to perform basic personal care (ADL) and independent living (IADL) functioning (Crimmins, Hayward, & Saito, 1994; Manton & Land, 2000). Such studies have demonstrated the value of this summarizing approach to understanding complicated differentials in mortality and disability by race and gender (Crimmins, Hayward, & Saito, 1996).

Few have examined concurrently the complex links between obesity and the health processes determining active life expectancy in the older population. To date, only one article examines obesity and total and disabled life expectancy (Peeters, Bonneux, Nusselder, De Laet, & Barendregt, 2004). Using the Original and Offspring Framingham Heart Study participants, the authors found that obesity implied higher mortality rates, shorter length of life lived free of disability, and no difference in the length of life lived with disability. However, the sample was not representative of the general population, and their approach examined the onset of disability over two points, spanning a 46-year period from midlife to old age. Another study by Visscher and colleagues (2004) examined obesity and unhealthy life years in adult Finns and found that obesity was more strongly related to morbidity and disability than to mortality.

Our review of the literature would lead us to expect that obesity may have a larger effect on disability than mortality among the older population. Because mortality, disability, and the prevalence of obesity are known to differ by gender (Crimmins, Saito, & Reynolds, 1997; Elo & Preston, 1996; Flegal, Carroll, Ogden, & Johnson, 2002), it is important to estimate active life expectancy by gender. Therefore, this article addresses two questions: How does obesity affect the average length of life for men and women aged 70 years and older, and how does obesity affect the length of nondisabled life among older men and women in the United States?

Research Design

The Data

We utilized data from the first three waves of Asset and Health Dynamics Among the Oldest Old (AHEAD) for this analysis. The first wave began in 1993–1994, followed by the second wave in 1995–1996; the third wave followed in 1998, resulting in an average interval of 2 years between the first and second waves and 2.25 years between the second and third waves. The 1993–1994 baseline sample began with interviews of 8,222 individuals who were a representative sample of community-dwelling adults aged 70 and older. Although their spouses or partners were included in the sample, 779 age-eligible spouses and partners were excluded from this analysis \( n = 7,443 \). After eliminating respondents for whom dates of birth \( n = 57 \), dates of death \( n = 4 \), and initial functioning status \( n = 1 \) could not be determined, the sample consisted of 7,381 individuals in 1993. This sample was followed through the third wave, by which time 1,894 had died. Deaths and the date of death were determined through the National Death Index (NDI), as well as reports of survivors. The date of death provided by the NDI was used when available; when no date was available from the NDI, the survivor-provided date of death was used. In addition, there were 249 cases with no information on ADL disability after the first interview, leaving a sample of 7,132.

All results were weighted to reflect the 70+ population. Details on the AHEAD survey design and procedures are readily available and are not repeated here (University of Michigan, 2004).

Measures

Active versus disabled life.—In this analysis, we defined active life as having no difficulty performing
any functions necessary for day-to-day personal care (ADLs); we defined disabled life as having difficulty in one or more of six ADLs. These activities include walking across a room, bathing or showering, eating, dressing, toileting, or transferring in or out of bed. In addition, while the original sample consisted solely of community-dwelling older adults, respondents may have been in nursing homes in subsequent waves. Anyone residing in a nursing home at either Wave 2 or Wave 3 was defined as disabled.

**Obesity.**—Obesity was based on calculations of BMI determined by self-reports of height and weight at the first wave. Obesity was defined as a BMI of 30 or over, consistent with current World Health Organization standards (WHO Expert Consultation, 2004).

### Statistical Analysis

We used a multistate life table method to estimate total and active life expectancy appropriate for use with longitudinal data. The method takes into consideration the fact that individuals experience both declines and improvements in disability; it also allows different mortality profiles by disability state (Crimmins et al., 1994). For the estimation of active life expectancy, we designated two live states—(a) active, no difficulties with any of the six ADLs listed above, and (b) disabled, difficulty with at least one of the six ADLs—and one absorbing state, dead (Figure 1). Estimates of active and disabled life expectancy were derived from age-specific transition rates for the six types of health events that can occur: deaths from each of the live states and movement into and out of disability, and remaining in the same state.

We used the Interpolation of Markov Chains (IMaCh) approach to estimation of transition schedules and life expectancy (Lièvre, Brouard, & Heathcote, 2003). IMaCh is designed to incorporate multiple waves of data and different interval lengths between survey waves and can incorporate cases with missing data. IMaCh also produces confidence intervals for the age-specific transition schedules and life-expectancy estimates. IMaCh uses a multinomial logistic regression approach to estimating age-specific health transitions. These transition rates are used to estimate total life expectancy, active life expectancy, and the health structure of the life table population implied by the rates (Crimmins et al., 1994). In this analysis, gender and obesity were included as covariates.

We have presented the probability of dying and of moving in and out of disability in graphic form, showing the estimated transition rates with 95% confidence intervals. We also have presented estimates of average total and active life expectancy for obese and nonobese older adults in tabular form, with 95% confidence levels.

### Results

#### Health Transitions of Obese and Nonobese Men and Women

We first present descriptive data detailing initial and ending states for obese and nonobese older men and women during the study period, 1993 to 1998 (Table 1). Information on the distribution of the sample by initial state in 1993 and final state in 1998 is shown. While information from the 1995 wave is included in estimating transition rates, for ease of presentation, it is not in this descriptive table. Nearly half of the sample members were active in 1993 and remained active in 1998; 7.5% were disabled in both 1993 and 1998; 13.3% became disabled, 4.4% recovered from disability by 1998, and one quarter died by 1998. Of course, many of these people could have made multiple moves that are not captured in this table.

About 13.2% of the population aged 70 and over was obese in 1993, and women were more likely than men to be obese (15.1% vs 10.2%). Obese older adults were less likely to remain active than nonobese adults (41.5% vs 50.5%) but were more likely to remain disabled (14.5% vs 6.4%). Obese older adults were less likely to die (20.5% vs 26.4%), more likely to become disabled (16.7% vs 12.7%), and slightly more likely to recover to active status (6.8% vs...
4.0%). Generally, the differences between obese and nonobese men and women were similar, except by degree. For example, obese men were 8.6 percentage points less likely to die than nonobese men (22.8% vs 31.4%), while obese women were 3.5 percentage points less likely to die than nonobese women.

The estimated age-specific transition rates that form the basis for calculating total, active, and disabled life expectancy for obese and nonobese older adults are presented for men and women (Figures 2–4). Figure 2 shows the 2-year probability of dying at each age for obese and nonobese adults. Mortality increased with age from a level of about 5% per year for men at age 70 to about 50% at age 95; these numbers are somewhat lower for women. There was no significant difference in the probability of death between obese and nonobese men (Figure 2, part A). The results for women were similar, as Figure 2, part B suggests little difference in the probability of death between obese and nonobese women.

There were, however, differences in the likelihood of becoming disabled for obese and nonobese adults (Figure 3). For both men and women, those who were obese had a significantly higher probability of becoming disabled across the older ages. For instance, obese women at age 80 had a 27% likelihood of becoming disabled; for nonobese women, the figure was 18%. The likelihood of becoming disabled for women who were both obese and nonobese was somewhat higher than for men in the same groups. Two-year probability of becoming disabled for the group with the highest rates—obese women—was about 13% at age 70 and 45% at age 90.

The likelihood of recovering from disability is shown in Figure 4. There was no significant difference between obese and nonobese men or women in the probability of returning to activity. For both genders, the probability of recovering from disability was much higher at younger ages than at older ages.
Total, Active, and Disabled Life Expectancy

Estimations of total, active, and disabled life expectancy are presented in Table 2. For men, total life expectancy was estimated to be 12.3 for the nonobese and 12.4 for the obese. At each age, total life expectancy for obese and nonobese men was about the same. However, for the obese, the years lived with disability were longer, and the years lived free of disability were shorter. At age 70, nonobese men could expect to live 10.5 active years and 2.3 years with disability. Obese men could expect to live only 9.1 active years and 3.5 years with disability. This means that obese men would spend one third (33%) of their expected life disabled; and nonobese men would spend one fifth (20%) of their expected life disabled. At older ages, the proportion of life lived with disability increased for both the obese and the nonobese, but it was higher at each age for the obese.

For women, the total years lived as well as those lived both active and disabled were longer than for men. At age 70, nonobese women could expect to live 15.3 years; obese women could expect to live 15.5 years. Similar to men, nonobese women lived more active years and fewer disabled years than obese women. At age 70, nonobese women averaged 10.5 active years and 4.8 years with disability. For the obese, these numbers were 7.4 and 8.4 years. At age 90, almost three fourths (74%) of life for obese women was expected to be disabled.

As expected, women lived more years, more active years, and more disabled years than men. Obese women were the group with the longest expected disabled life—7.4 years at age 70.

Discussion

In summary, we found that obesity had little effect on life expectancy for either older men or women, once people had reached age 70. These results are consistent with the literature on age, obesity, and mortality, which generally indicate a lessening of the link between obesity and mortality with increasing age (Ferraro et al., 2003; Thorpe & Ferraro, 2004). Active life expectancy, however, is significantly shorter and disabled life expectancy significantly longer for obese persons at older ages. Our results are also consistent with the literature indicating that obesity has a deleterious effect on older adults’ ability to function (Peeters et al., 2004; Visscher et al., 2004).

Our approach to estimating the effect of obesity allows us to conclude that at age 70, when compared to a nonobese woman, the average obese woman can expect to live 2.4 years less being able to perform all
ADLs without difficulty and 2.6 years longer with ADL problems. The average obese man lives 1.4 fewer active years than a nonobese man at age 70 and 1.5 more disabled years.

Having difficulty with ADL tasks is often associated with the need for personal care so the excess years of disability can be difficult for both the individuals and their families. In order to better understand the population impact of obesity, we estimated the excess disabled years in the 1995 population associated with being obese by weighting the average number of years lived in disability among the obese and the nonobese by their representation in the population. If we assume that the obese lived the same number of years in disability as the nonobese, the total number of years lived with ADL disability in the 70+ population would be reduced by 8% among older women and 5.4% among older men. Obesity has increased at all ages in recent decades and is projected to increase in the future (Arterburn, Crane, & Sullivan, 2004). This, along with projected increases in the number of older persons, means that there will be significant increases in disability, absent interventions to retard or halt the increase in adult obesity in the United States. This would mean a significant change in current trends toward improving disability, as well as a major impact on our health care systems (Arterburn et al.).

To date, few studies of interventions to reduce obesity in older adults have been conducted. Major questions related to interventions in obesity include the ability of older adults to lose weight intentionally, the best means of accomplishing intentional weight loss, and what factors influence the success or failure of potential weight loss interventions.

Several studies have found older adults able to lose either weight or body fat, but these studies vary widely in the length of clinical trials, from 3 to 6 weeks (Hays, DiSabatino, Gorman, Vincent, & Stillabower, 2003; Sartorio, LaFortuna, Agosti, Proietti, & Maffiuletti, 2004) to 9 months to a year (Binder et al., 2002; Zhu et al., 2003). Although there is little evidence to suggest that older adults cannot lose weight intentionally, lack of success in maintaining weight loss in adults who are overweight implies that prevention of obesity may be more effective in the long term (Lee et al., 2001).

In terms of effective means of accomplishing reductions in obesity, there is conflicting evidence on whether diet (or proper nutrition) or physical activity is best. For example, Hays and colleagues (2002) found that eating behaviors were strongly related to prevention of adult-onset obesity. In addition, Zhu and colleagues (2003) studied caloric restriction weight loss, exercise programs, and weight-reducing medications and concluded that weight loss through dieting was the most beneficial. In another study, Hays and colleagues (2003) found evidence of weight loss with a high saturated fat and no-starch diet successfully reduced obesity without harmful effects on lipids; however, this study was conducted over just 6 weeks. Other studies place a higher emphasis on physical activity as a means to reducing obesity and its effects (Bijnen, Feskens, Caspersen, Mosterd, & Kromhout, 1998; Binder et al., 2002).

Finally, in order to maximize the effectiveness of potential interventions on reducing obesity in older adults, more research should focus on factors that impact both obesity and the ability to respond to treatment for obesity. Physical activity levels for example, have been found to vary by gender and ethnicity (Bijnen et al., 1998), attitudes and psychosocial attributes, such as body-image (DiPietro, 2001; King, Taylor, Haskell, & DeBusk, 1988), self-motivation, and earlier-age activity levels (King, 2001). There is a great deal more research needed to determine the most effective ways to reduce obesity in older adults; however, the implications of this article suggest that the impact of obesity on disability in older adults makes research of potential interventions worthwhile for those even at the oldest ages.

This study has some limitations, including the reliance on self-reported obesity at one point in time. First, there is evidence that there are gender differences in the accuracy of self-reports of weight, particularly by women, who are likely to underreport their weight (Bendixen et al., 2004). Consequently, it is possible that our results represent an underestimation of the impact of obesity on older women. Second, we did not know the history of weight change among the sample so we did not incorporate this in our analysis; in addition, there was very little change in weight over the 5 year period, so analysis of weight change during the period was not examined. Another limitation is the small number of obese persons, particularly at the oldest ages; it is possible that analysis of the oldest ages was hampered by lack of statistical power.

Public health policy for older adults should be concerned with the prospect of growing numbers of longer-lived disabled obese adults (Arterburn et al., 2004), particularly since obese respondents in AHEAD also had high levels of hypertension, diabetes, and arthritis (data not shown), conditions also associated with disability in old age. In addition to further study on the impact of obesity on functioning, disability, disease, and death, future research should also focus on effective means of reducing obesity. While this study presents further evidence that obesity has decidedly negative effects on the quality of life for adults aged 70 years and older, other research indicates that reduction of obesity in older adults is complicated, but quite possible (Binder et al., 2002; Hays et al., 2003; Sartorio et al., 2004; Zhu et al., 2003). This study also suggests that such interventions could have a major impact on disability rates in older adults, particularly those who are at high risk for disability and obesity.
References


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