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Body Mass Index, Weight Loss, and Mortality in Community-Dwelling Older Adults

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Abstract

Background—The relationship between body mass index (BMI), weight loss, and mortality in older adults is not entirely clear. The purpose of this article is to evaluate the associations between BMI, weight loss (either intentional or unintentional), and 3-year mortality in a cohort of older adults participating in the University of Alabama at Birmingham (UAB) Study of Aging.

Methods—This article reports on 983 community-dwelling older adults who were enrolled in the UAB Study of Aging, a longitudinal observational study of mobility among older African American and white adults.

Results—In both raw and adjusted Cox proportional hazards models, unintentional weight loss and underweight BMI were associated with elevated 3-year mortality rates. There was no association with being overweight or obese on mortality, nor was there an association with intentional weight loss and mortality.

Conclusions—Our study suggests that undernutrition, as measured by low BMI and unintentional weight loss, is a greater mortality threat to older adults than is obesity or intentional weight loss.

THE relationship between body mass index (BMI), weight loss, and mortality in older adults is not entirely clear (1). Matters that remain unresolved include: (i) the shape of the curve regarding the relationship between BMI and mortality; (ii) whether a difference exists between intentional and unintentional weight loss in predicting mortality; and (iii) whether any relationship that may exist between weight loss—either intentional or unintentional—and mortality varies according to BMI status.

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In older adults, researchers have shown various patterns depicting the association between BMI and mortality. Reasons for discrepancies in these studies include real variations in the study samples as well as methodological differences. Most epidemiological studies suggest that older persons in the lowest BMI categories have the highest mortality, whereas those in the highest BMI categories have the lowest risk for mortality compared to those in the normal range (2–6).

The relationship between BMI and mortality in older adults may be confounded by several covariates, however, especially recent weight loss, which has generally been found to be associated with higher mortality in older adults across all BMI categories (7–10). Most studies have not distinguished between intentional and unintentional weight loss. This lack of distinction is problematic because recent unintentional weight loss associated with the presence of disease could obscure the true association between BMI and mortality in lean older people while inflating the benefit of being overweight or obese. Studies that have distinguished between unintentional and intentional weight loss and their effects on mortality have not produced consistent findings (11–13).

The purpose of this study is to evaluate the associations between BMI, recent weight loss (either intentional or unintentional), and mortality, while adjusting for other well-established predictors of mortality, in a cohort of older adults participating in the UAB Study of Aging.

Methods

Sample

One thousand community-dwelling older adults 65 years old or older were enrolled in the UAB Study of Aging, a longitudinal observational study of mobility among older African American and white adults. This article reports on 983 persons for whom BMI status was obtained. Baseline recruitment took place between December 1999 and February 2001, and was based on a random sample of Medicare beneficiaries stratified by race, gender, and rural/urban residence and residing in five central Alabama counties. The study is ongoing. The study protocol was reviewed and approved by the UAB Institutional Review Board.

Design

Participants were administered a baseline questionnaire in their homes. The questionnaire included assessments related to mobility and overall health status. Additionally, measurements of height and weight were obtained. Telephone interviews were subsequently conducted every 6 months for 3 years.

Measurement: Dependent Variable

Mortality—All-cause mortality over a 3-year period since enrollment in the study was the dependent measure. Mortality was verified through the Social Security Death Index (14).

Measurement: Independent Variables

Body mass index—BMI was assessed by obtaining height and weight of all participants who were able to stand (91.1% of participants). For participants unable to stand, height and weight were calculated from knee-height measures and arm circumference (n = 89). If knee height was unavailable, self-reported height and weight were used (n = 37).

BMI was calculated from weight in kilograms divided by height in meters squared, and was categorized according to the National Heart, Lung, and Blood Institute (NHLBI) Clinical Guidelines (1998) thresholds for underweight (BMI < 18.5), normal weight (BMI 18.5–24.9), overweight (BMI 25.0–29.9), Class I obesity (BMI 30.0–34.9), Class II obesity (BMI 35.0–

39.9), and Extreme/Class III obesity (BMI ≥40) (15). Because so few participants were categorized as Class III obesity, they were included with those categorized as Class II obesity.

Weight loss—Weight loss was assessed at baseline by asking two questions: "In the past year, have you lost weight (> 10 pounds)?" If participants answered yes to this question, they were then asked "Did you try to lose weight?" These questions were coded into a single item, the categories of which included: no weight loss, intentional weight loss, and unintentional weight loss.

Control Variables

Because of the potential effects of age, gender, ethnicity, smoking, and comorbidity, we controlled for these variable in our analyses. Age was included as a continuous variable. Smoking status was determined by whether the participant smoked at all in the past year. Verified comorbidities that are part of the Charlson Comorbidity Index were summed to develop a comorbidity count (16).

Statistical Analysis

Descriptive statistics were used first to characterize the sample (Table 1). Chi-square analyses or one-way analyses of variance, where appropriate, were performed to determine whether the BMI groups differed significantly on any of the baseline characteristics. Next, Cox proportional hazards models were run using SAS Proc PHREG (SAS, Cary, NC) to assess the univariate and multivariate effects of BMI, weight loss, and the control variables on time to death among participants who died in the 3-year period after enrollment in the study (17,18). Dropouts were censored at the date of their last participation in the study period. Surviving participants were censored 3 years postenrollment.

Results

Baseline characteristics are presented in Table 1. By design, the sample was 50% female and 50% African American. Mean age of the study sample was 75.3 years. There was a total of 147 deaths within 3 years of enrollment. Intentional weight loss was reported by 8.8% of participants, and unintentional weight loss was reported by 19.1%. Two percent of the sample was underweight, 29.3% were normal weight, 37.7% were overweight, 20.3% were obese class I, and 10.5% were obese class II or III. Baseline characteristics differed significantly by BMI category.

In both the raw and adjusted Cox proportional hazards models (Table 2), older age, male gender, recent smokers, greater comorbidities, intentional weight loss, and Underweight BMI category significantly predicted mortality. In the adjusted model, underweight participants were more than 2 times as likely to experience mortality within 3 years compared with participants in the Normal Weight BMI category. There was no association between being overweight, obese, or grossly obese and mortality. In the adjusted model, older adults reporting unintentional weight loss were 1.67 times more likely to experience mortality than those who reported no weight loss. There was no difference in mortality between participants who reported intentional weight loss and those who reported no weight loss. There was also no association between race and 3-year mortality.

An additional proportional hazards model was conducted that included a BMI Group × Weight Loss Group interaction effect. This interaction effect was not statistically significant (χ^2 (7) = 1.04, p = .99). Combining this with the multivariable findings in Table 2, it was evident that both the Underweight BMI effect and the unintentional weight loss effect were independent

of each other, and that the effect of unintentional weight loss on mortality did not differ as a function of BMI group.

Conclusion

Our findings indicate that older adults who were either underweight or experienced unintentional weight loss had a higher risk of mortality compared with those who were normal weight, overweight, or obese and who did not experience unintentional weight loss. Additionally, older adults who were either obese or grossly obese had the lowest risk of mortality compared to all other groups. Our findings are consistent with those of other studies that found a reverse j-shaped relationship with BMI and mortality (19–21).

Our study has implications for public health in several regards. First, despite increasing rates of obesity occurring among all age groups in society, a significant proportion of the older population continues to experience undernutrition (22,23). There are many causes of undernutrition that may be amenable to conservative treatment. Second, although not statistically significant, the nature of the relationship between intentional weight loss and mortality suggests that there might have been a beneficial effect. These findings are consistent with the findings of Gregg and colleagues (24), who included only overweight and obese adults in their study.

This is an observational study limited by the difficulty inherent in relying on a self-report measure to distinguish between intentional and unintentional weight loss (25,26). Our study is also limited in that it was of only 3 years duration, the exact amount of weight lost is not known, and the weight loss question was asked only with regard to the previous year. An additional limitation of this study is that we do not have measures of the distribution of body fat and, specifically, intra-abdominal fat, which some researchers have indicated may be more important than BMI in predicting mortality (26). This study, as well as others, indicates the need for randomized clinical trials that carefully evaluate the effect of weight reduction, caloric intake, and physical activity on morbidity and mortality in community-dwelling older adults.

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Table 1

Baseline Characteristics

Variable	Whole Sample (*N* = 983)	Underweight (*N* = 21)	Normal Weight (*N* = 288)	Overweight (*N* = 371)	Obese Class I (*N* = 200)	Obese Class II (*N* = 103)	*p*
Age (mean, *SD*)	75.30, 6.72	76.29, 5.93	77.09,7.20	74.89, 6.54	74.55, 6.31	72.98, 5.70	< .0001
Gender, %							
Male	50.46	57.14	45.49	58.76	47.50	38.83	
Female	49.54	42.86	54.51	41.24	52.50	61.17	.0006
Race, %							
AA	49.54	57.14	35.42	47.44	63.00	68.93	
White	50.46	42.86	64.58	52.56	37.00	31.07	< .0001
Smoker, %	13.12	33.33	14.93	11.86	14.00	6.80	.0133
Comorbidity count (mean, *SD*)	2.48, 1.65	2.48, 1.57	2.29, 1.65	2.30, 1.58	2.66, 1.56	3.31, 1.85	< .0001
Recent weight loss, %							
None	72.13	47.62	69.10	78.44	72.00	63.11	
Intentional	8.75	4.76	3.13	9.16	11.00	19.42	
Unintentional	19.13	47.62	27.78	12.40	17.00	17.48	< .0001
3-year mortality, %	14.95	38.10	16.32	15.90	10.50	11.65	.0090

Note: SD = standard deviation; AA = African American.

Table 2

Cox Proportional Hazards Models

	Univariate Models				Multivariable Model			
Predictor	**Est**	**HR**	**95% CI**	***p***	**Est**	**HR**	**95% CI**	***p***
Weight loss								
Intentional vs none	–0.66	0.52	0.23-1.17	.1145	–0.49	0.62	0.27–1.42	.2532
Unintentional vs none	0.61	1.84	1.28-2.63	.0009	0.51	1.67	1.14–2.45	.0080
BMI category								
< 18.5 vs 18.5–25	1.01	2.74	1.30-5.80	.0084	0.78	2.18	1.02–4.66	.0451
25–30 vs 18.5–25	–0.01	0.99	0.67-1.45	.9437	0.22	1.25	0.83–1.87	.2834
30–35 vs 18.5–25	–0.49	0.61	0.37-1.02	.0616	–0.18	0.83	0.49–1.42	.5019
> 35 vs 18.5–25	–0.36	0.70	0.37-1.32	.2677	–0.08	0.92	0.47–1.80	.8131

Notes: Data are adjusted for age, gender, race, smoking status, and comorbidities.

Est = estimate; HR = hazards ratio; CI = confidence interval; BMI = body mass index.