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Involuntary Weight Loss in Older Outpatients: Incidence and Clinical Significance

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OBJECTIVES: To describe the incidence, anthropometric parameters, and clinical significance of weight loss in older outpatients.

DESIGN: Four-year prospective cohort study.

SETTING: University-affiliated Veterans Affairs Medical Center.

PATIENTS: Two hundred forty-seven community-dwelling male veterans 65 years of age or older.

MEASUREMENTS: Anthropometrics (weight, height, skinfolds, and circumferences), health status measures (Sickness Impact Profile scores, health care utilization, self-reported ratings of health), and bloodwork (cholesterol, albumin, others) were obtained at baseline and followed annually for 2 years. Outcome measures (hospitalization, nursing home placement, and mortality rates) were followed for a minimum of 2 years after any identified weight change.

MAIN RESULTS: The mean annual percentage weight change for the study population was −0.5% (SD: ±4.0%; range: −17% to +25%). Four percent annual weight loss was determined to be the optimal cutpoint for defining clinically important involuntary weight loss using ROC curve analysis. The annual incidence of this degree of involuntary weight loss was 13.1%. At baseline, involuntary weight losers were similar to nonweight losers in age (73.9 ± 7.9 vs 73.3 ± 6.7 years), body mass index (26.8 ± 3.9 vs 26.9 ± 4.1 kg/m^2),and all other anthropometric, health status, and laboratory measures. Relative to nonweight losers, involuntary weight losers had significantly ($P \leq .05$) greater decrements in central skinfold and circumference measures (subscapular skinfolds, −2.9 vs −0.4 mm; suprailiac skinfolds, −4.2 vs −0.2 mm; and waist to hip ratio, −.01 vs +.00). Both groups had significant decreases in their triceps skinfolds (an estimate of peripheral subcutaneous fat), whereas arm muscle area and albumin levels did not decline significantly in either group. Over a 2-year follow-up period, mortality rates were substantially higher (RR = 2.43; 95% CI = 1.34–4.41) among involuntary weight losers (28%) than among non-weight losers (11%). Of interest, a similar increase in 2-year mortality (36%) was also observed among subjects with voluntary weight loss (by dieting). Survival analyses adjusting for differences between weight losers and nonweight losers in baseline age, BMI, tobacco use, and other health status and laboratory measures yielded similar results.

CONCLUSIONS: These results indicate that involuntary weight loss occurred frequently (13.1% annual incidence) in this population of older veteran outpatients. When involuntary weight loss occurred, the predominant anthropometric changes were decrements in measures of centrally distributed fat (trunkal skinfolds and circumferences). Finally, involuntary weight loss greater than 4% of body weight appears to be clinically important as an independent predictor of increased mortality. **J Am Geriatr Soc 43:329–337, 1995.**

Weight loss and malnutrition have been cited as common problems in older populations[1–10] and have been associated with adverse health outcomes such as infections, poor wound healing, and death.[11–20] However, our knowledge of the problem of weight loss in ambulatory geriatric populations remains limited as previous studies have often focused on hospitalized or nursing home patients,[10–17] and community based studies have often included few subjects over age 65, relied upon self-reported weight changes, and/or have not distinguished between voluntary and involuntary weight loss.[18–23] In addition, studies investigating the causes and clinical significance of weight loss have frequently used different degrees and rates of weight loss to define their study populations.[10–13,19,20] Further, studies demonstrating increased mortality among weight losers have generally not described accompanying physiologic changes that might enhance our understanding of the relationship between weight loss and subsequent morbidity and mortality.[11–13,19,20] Finally, in contrast to studies involving hospitalized or nursing home patients, Thompson and Morris reported a relatively low mortality rate among older outpatients with unexplained weight loss.[24] Thus, the parameters for weight loss that should prompt concern and investigation and the significance and extent of this problem in community-dwelling geriatric populations remain poorly characterized. To better address these issues, we analyzed data from a prospective study on nutrition and health in older veteran outpatients to (1) deter-

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mine the incidence of various degrees of weight loss, (2) describe changes in anthropometric measures of body fat and muscle that accompany weight loss and (3) evaluate the association between weight loss and adverse health outcomes.

METHODS

Design

The primary study from which data were obtained was a large (n = 300) prospective cohort study on nutrition and health conducted at the Seattle VA Medical Center (SVAMC) from 1986 to 1989. For the purposes of this weight loss study, follow-up for mortality was extended to 1991.

Persons eligible for inclusion were community-dwelling males, older than age 65, who received their medical care through the SVAMC or were VA eligible and living in King County, Washington. Veterans receiving care at the SVAMC were recruited by random sampling of patients enrolled in VA medicine clinics or in the VA Hospital-Based Homecare Program. The VA eligible veterans living in King County but not receiving their medical care at the SVAMC were recruited by random mailings.

Subjects with diseases known to be associated with poor nutrition and weight loss were excluded from recruitment. These illnesses included: terminal illness (diagnosis of a terminal condition or expected survival time < 1 year mentioned in the medical record); renal failure (BUN > 100 mg/dL, Cr > 10 mg/dL, or on dialysis); severe pulmonary disease (FEV1 < 0.7 L/sec); thyroid dysfunction (T4RIA or TSH > 3 standard deviations from the laboratory mean within the previous 6 months); poorly controlled diabetes mellitus (DKA or diabetic coma within the last year); protein-losing enteropathy or nephropathy; severe hepatic dysfunction (liver failure, active hepatitis or hepatic dysfunction history); or significant fat malabsorption (elevated stool fat documented within past 6 months). In order to enter patients who were relatively medically stable, subjects were excluded if they had been hospitalized within 3 months before enrollment. Patients disoriented to name, place, or time were also excluded. The small percentage of minorities in the potential study population severely limited the enrollment of minority older persons. As oversampling was felt unlikely to make the study population more generalizable or allow analysis by race, only whites were recruited.

Data Collection

Nutritional and health status measures were obtained at entry (time 0) and again at approximately 12 and 24 months. Each of these evaluations consisted of a review of medical records, interviews and completion of a health and nutrition questionnaire administered by trained study personnel, and a physical examination which included anthropometric and laboratory measures.

The medical record provided information on the subject's age, medical diseases, medications, and hospitalizations. The interviews and questionnaire addressed potential predisposing factors for poor nutrition and weight loss, including socioeconomic status, psychiatric and medical problems, medication use, tobacco and alcohol use, and functional disabilities. The research dietitian obtained detailed information on daily activities and dietary history, including a yearly 24-hour dietary recall and food frequency survey. Patients were asked specifically if they were on a special diet to try to lose weight. The Sickness Impact Profile (SIP), a valid and reliable measure of health and functional status,[25] was administered yearly.

The examinations were performed by the same research dietitian to minimize interobserver variation. All anthropometric measures were performed utilizing standardized methods, and each measure was repeated three times and averaged.[26,27] Weights were obtained on a clinic scale, with the patient stripped to his underclothes, and recorded to the nearest 0.1 kg. Body Mass Index (BMI) was calculated as a measure of obesity {$BMI= weight(kg)/height^2(m^2)$}.[28] Triceps, subscapular and suprailiac skinfolds were measured using skinfold calipers on the subject's right side. Triceps skinfold measures estimate peripheral subcutaneous fat, and subscapular and suprailiac skinfolds estimate central subcutaneous fat stores.[29–31] Height, waist, hip, and arm circumferences were obtained with a flexible steel tape measure. Waist to hip ratios were calculated as a measure of central body fat distribution.[32] Mid-arm circumference (MAC) and corrected arm muscle area (CAMA) measures were used to estimate muscle mass {$CAMA = [(MAC - \pi \times TSF)^2/4\pi] - 10$}.[33] Test-retest reliability of circumference and skinfold measures was $_r = .99$.

To obtain laboratory measures, all blood samples were drawn in the morning after an overnight fast. Serum albumin levels were obtained as a measure of body protein and nutritional status.[34] Cholesterol levels (run at the University's Clinical Nutrition Research Unit), total lymphocyte counts, and vitamin and mineral levels were also measured annually.

Outcome measures of interest were hospitalization, nursing home placement, and mortality rates. Subjects were followed for the occurrence of these events for a minimum of 2 years after being categorized as either weight losers or nonweight losers (as described below). The follow-up period was considered to begin after year 1 for persons with weight loss during year 1 (and also for subjects with no weight loss during year 1 who had no further weights measured in year 2); after year 2 for subjects with weight loss during year 2; and after year 2 for subjects without weight loss during either year. Causes of death were determined by chart review conducted by a physician investigator (JIW), supplemented as needed by information from subjects' families and physicians.

Data Analysis

Defining Weight Loss

The data on individual's weights at 0, 12 and 24 months were reviewed to describe the frequency, direction, and magnitude of annual weight changes. The available literature on involuntary weight loss often refers to losses greater than 5% of body weight as "significant" decrements.[1,35] In addition, two retrospective studies on unintentional weight loss have used this degree of weight loss over 6 to 12 months as enrollment criteria for defining patients as "weight losers."[11,12] Therefore, in our initial analyses, we used 5% as the cutpoint for classifying individuals as "weight losers." Then, to better determine what degree (if any) of annual weight loss was "clinically significant" in our population, we evaluated the association of varying percentages of weight loss with subsequent mortality, utilizing receiver operating characteristic (ROC) curves.[36] The percentage of annual weight loss determined to be optimal for its association with mortality was 4% (see Results). Therefore, following the initial analysis with 5% as the cutpoint, all further analyses were conducted utilizing 4% to define significant weight loss.

Men losing this amount of weight in *either* the first (0–12 months) or second year (12–24 months) of the study were categorized as weight losers. Subjects without this degree of weight loss during the study period were categorized as nonweight losers (NWL). Weight losers who indicated on the questionnaire that they were on a special diet to lose weight were categorized as voluntary weight losers. Weight loss associated with the initiation of new or increased doses of diuretics was defined as diuretic induced. Subjects whose weight loss was not attributable to dieting or diuretics were categorized as involuntary weight losers (IWL).

Statistical Methods

The annual incidence of involuntary weight loss of 4% or greater was calculated. Involuntary weight losers were compared with NWL for differences in baseline demographic, health status, anthropometric and laboratory measurements (two-tailed t tests). Changes in measures of health status (self-rated health status and SIP scores) and anthropometric indices that occurred among IWL (during the year they lost weight) were compared with annual changes among NWL (two-tailed t tests). Differences in rates of hospitalization in the year before, during, and after weight changes were tested by chi-Square analysis. Because nursing home placement was a rare event ($n = 2$), it was not a useful endpoint measure in this study. The mortality rates of IWL and NWL were compared (Chi-Square) and further evaluated utilizing Kaplan-Meier survival analysis methods. Proportional Hazards (Cox) and Logistic Regression methodologies were used to investigate the association between mortality and weight loss after controlling for other factors associated with mortality. These included age, BMI, tobacco use, the presence of comorbid disease (hypertension, diabetes, history of cancer, ischemic heart disease), and poor health status (as indicated by Sickness Impact Profile Scores, self-rated health, and albumin and cholesterol levels).

Table 1. Study Cohort Demographic and Clinical Characteristics*

Characteristic	Study Group (n = 247)
Demographics	
Age (years)	72.9 ± 6.9
Marital status (%)	
Never married	4.3
Married	73.6
Divorced/separated	14.0
Widowed	8.0
Live alone (%)	18.5
Education level (%)	
<High school	31.8
High school	24.6
>High school	43.6
Income ($ × 1,000)	18.6 ± 11.4
Clinical characteristics	
BMI (Kg/M^2)	27.1 ± 4.7
Self-rated health (%)	
1 Excellent	14.5
2 Very good	27.0
3 Good	37.1
4 Fair	17.7
5 Poor	2.8
Albumin (gm/dL)	4.4 ± 0.5
Cholesterol (mg/dL)	223 ± 43
Energy intake (Kcals/day)	1853 ± 616
Tobacco Use (%)	
Current	21.7
Former	59.3
Never	19.0
Self-reported diseases (%)	
Arthritis	55.6
Hypertension	50.8
Bronchitis, emphysema	23.8
Coronary Artery Disease	27.6
Diabetes	19.4

* Normally distributed data are presented as means ± SD. Other values are as defined in the table.

RESULTS

Participation Rate and Subject Characteristics

Of the initial sample population available for recruitment ($n = 1012$), 281 were excluded by criteria as follows: 106 lived in nursing homes or outside King County; 70 were not VA eligible; 65 were excluded by age, gender, or race; 16 were hospitalized within 3 months of enrollment; 16 had diseases associated with malnutrition or weight loss; eight had miscellaneous reasons. Three hundred of the remaining 731 subjects in the target population enrolled in the primary study for a participation rate of 41%. Of these, 53 persons were unable to be categorized as weight losers or nonweight losers for the purposes of this study because their weights were not followed for at least 1 year (19 died, 6 were placed in nursing homes, and 28 declined further participation during the first year).

The characteristics of the study cohort ($n = 247$) are presented in Table 1. Comparisons of health and sociodemographic variables between participants and those who did not participate showed the two groups to be very similar. These comparisons included age, marital status, living arrangements, education, number of hospitalizations in the previous year, and number of sick days in the previous month. Also, to help ascertain if the study cohort was representative of the larger population, National Health and Nutrition Examination Survey (NHANES) II data tapes were used to obtain information about white male veterans aged 65 to 74 (the oldest cohort in NHANES II) for comparison with study subjects in the same age range. Two hundred fifty-eight veterans were identified from the NHANES II national sample of noninstitutionalized US men. Relative to the NHANES II subjects, the study cohort was better educated (74% completed at least high school vs 52% NHANES II), heavier (83.3 kg vs 76.2 kg), and had higher prevalences of hypertension (53% vs 35%) and diabetes mellitus (23% vs 8%). Variables that were similar in the two cohorts included mean age (69.6 years vs. 68.3 NHANES II); marital status (78% married vs 80%); height (174 cm vs 172 NHANES II); daily caloric intake (1890 Kcal/d vs 1905); albumin level (4.4 gm/dL vs 4.7); self-rated health scores (1 = excellent, 5 = poor: 2.7 vs 3.1 NHANES II); and prevalence of chronic obstructive

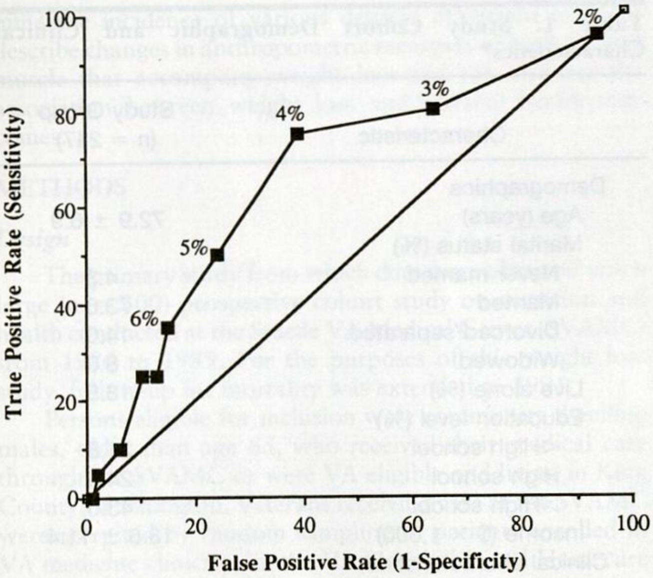

Figure 1. Receiver operating characteristic curve for the association of different degrees of weight loss with subsequent mortality.

pulmonary disease (22% vs 20%), and heart problems (18% vs 15% in NHANES II)

Weight Loss Definition

As previously noted, the available literature frequently, but somewhat arbitrarily, defines significant weight loss as decrements of greater than 5% of initial body weight.[1,11,12,35] Using this definition (a loss of >5% of initial body weight over a 1-year period) the annual incidence of involuntary weight loss in this study was 7.8% (33 cases per 421 person-years). Subjects with this degree of involuntary weight loss had a significantly higher mortality rate during a 2-year follow-up period (10/33 weight losers died, 30.3%) than those not meeting this definition of weight loss (27/198 expired, 13.6%): RR = 2.22 (95% CI: 1.19–4.15; $P = .02$).

Analysis of the ROC curves on the association between various degrees of involuntary weight loss and mortality (Figure 1 and Table 2) indicated that, in terms of sensitivity and predictive value, 5% was not the optimal cutpoint for defining clinically important weight loss in this study population. As demonstrated in Table 2, when a cutpoint of 4% was used (rather than 5%) the sensitivity for identifying persons whose weight loss was associated with subsequent mortality rose from 50% to 75%. While this increase in sensitivity was associated with a decline in specificity (76% to 61%) and overall accuracy (71% to 63%), the positive predictive value remained virtually unchanged (29% to 28%), and the negative predictive value improved from 88% to 92%.

Thus, the use of 4% (rather than 5%) for defining clinically important involuntary weight loss improved detection of patients whose weight loss was associated with increased mortality (true positives) while adding only a small number of cases whose weight loss was not associated with increased mortality (false positives). As can be seen in Table 2, a further decrease in the definition of significant weight loss from 4% to 3% only minimally improved sensitivity (75% to 80%) while markedly decreasing specificity (61% to 35%), predictive values, and accuracy (63% to 42%). We concluded, therefore, that 4% was the optimal cutpoint for defining clinically important weight loss in our population.

Table 2. Receiver Operating Characteristic Curve Analysis: Test Characteristics at Various Degrees of Involuntary Weight Loss

Weight Loss %	Sensitivity	Specificity	PPV	NPV	ACC
−6%	35%	85%	32%	87%	76%
−5%	50%	76%	29%	88%	71%
−4%	75%	61%	28%	92%	63%
−3%	80%	35%	20%	90%	42%

PPV = positive predictive value.
NPV = negative predictive value.
ACC = accuracy, % correctly classified.

Incidence

The annual incidence of involuntary weight loss of 4% or greater was 13.1% (10.5% in year 1 and 16.8% in year 2). A flow diagram of subject's weight changes during the 2-year period in which weights were followed is depicted in Figure 2. Of the 25 subjects with involuntary weight loss in year 1, only one regained his lost body weight during year 2. On average, year 1 IWLs lost an additional 1% of body weight during year 2 of the study (though only two subjects lost an additional ≥4% during year 2).

All further comparisons of involuntary weight losers to nonweight losers reflect analysis of data from the 54 IWL (25 IWL in year 1 combined with 29 IWL in year 2) and the 175 NWL (175 persons were NWL in year 1 and then were either NWL (n = 144) or had no follow-up weights (n = 31) during year 2). Before combining data, analyses were conducted comparing IWL and NWL in year 1 and year 2 separately. As the findings were similar, only the results of the combined analyses are presented.

Descriptive Measures

Involuntary weight losers were similar to nonweight losers in age, weight, and all other baseline anthropometric measures (Table 3a). The subjects did not differ significantly in any of their baseline health status measures except that fewer IWL than NWL were hospitalized in the year preceding their weight change (Table 3b).

Annual changes that occurred in the anthropometric and health status measures among involuntary weight losers and nonweight losers are shown in Table 4.

The mean weight loss among IWL was 5.6 kg (6.9%). Relative to NWL, the IWL had significantly greater decrements in subscapular [−2.9 mm (−15%) vs −0.4 mm

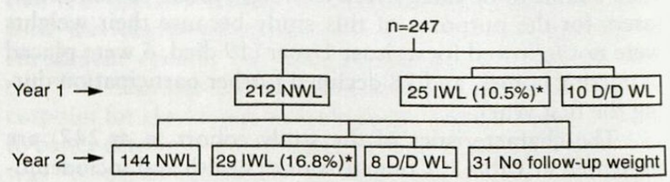

Figure 2. Incidence Data: Involuntary weight loss ≥ 4% of initial body weight. IWL = Involuntary Weight Loser; NWL = Nonweight Loser; D/D = Diet- or Diuretic-Related Weight Loser. *Overall annual IWL incidence = 13.1%.

Table 3a. Baseline Subject Characteristics*

Measure	Involuntary Weight Loser (n = 54)	Nonweight Loser (n = 175)
Age (years)	73.9 ± 7.9	73.3 ± 6.7
Weight (Kg)	80.8 ± 15.3	80.7 ± 14.1
BMI (Kg/m²)	26.8 ± 3.9	26.9 ± 4.1
Skinfolds (mm)		
Triceps	15.1 ± 6.3	15.1 ± 5.9
Subscapular	19.6 ± 7.2	20.4 ± 6.7
Suprailiac	21.8 ± 7.9	22.1 ± 7.3
Waist/Hip ratio	1.00 ± 0.03	1.01 ± 0.03
Arm muscle area (cm²)	46.1 ± 10.4	46.2 ± 9.2

* Values are means ± SD. All P values for differences between IWL and NWL in the above measures were not statistically significant ($P \geq 0.10$, two-tailed t tests).

Table 3b. Baseline Health Status Measures*

Measure	Involuntary Weight Loser (n = 54)	Nonweight Loser (n = 175)
Self-Rated Health (1 = excellent, 5 = poor)	2.5 ± 1.0	2.6 ± 0.9
SIP Score** (higher = poorer health)	8.3 ± 9.3	8.7 ± 10.2
Clinic Visits (mean number in previous year)	7.7 ± 8.2	8.2 ± 9.7
Hospitalizations (# hospitalized in previous year)	7/54 (13%)	45/174 (26%)***
Albumin (gm/dL)	4.3 ± 0.3	4.3 ± 0.3
Cholesterol (mg/dL)	223 ± 33	222 ± 43
Tobacco Use		
Current	24%	20%
Former	52%	62%
Never	24%	18%

* Values are means ± SD and all p-values for differences between IWL and NWL in the above characteristics were not statistically significant ($p \geq .10$, two-tailed t-tests) unless otherwise noted.
** SIP Scoring Scale: 0–3 = Healthy, ≥20 = 3+ ADL disabilities.
*** p-value = 0.05 (Chi-Square Test).

(−2%)] and suprailiac skinfolds [−4.2 mm (−19%) vs −0.2 mm (−1%)] and in waist/hip ratios. Both groups had significant decreases in their triceps skinfolds, with a trend (P = .06) toward greater decrements among IWL subjects [−2.6 mm(−17%) vs −1.4 mm (−9%)]. Arm muscle area remained stable among IWL but increased by 2.9 cm² (6%) in NWL. Changes in SIP scores and self-rated health were similar among IWL and NWL, and neither group had significant changes in their albumin levels.

Outcome Measures

In terms of the outcome measures of interest (Table 5), the two groups did not differ significantly in rates of hospitalization in the year following weight change (IWL 34% vs NWL 31%, P = .69). Involuntary weight losers did have slightly higher (but not statistically significant) hospitalization rates during the year they lost weight (IWL 35% vs NWL 28%, P = .28).

Over a 2-year follow-up period, the IWL group had a higher mortality rate (28%) relative to NWL (11%), RR = 2.43 (95% CI: 1.34–4.41, P = .003). Kaplan-Meier curves illustrate each groups' survival experience (Figure 3). To rule out the possibility that we were simply observing an increased mortality rate at one end of a bell-shaped weight change curve (the mean weight change for the cohort was 0% ± 4%), the survival experience of subjects with annual weight gains of 4% or greater was evaluated. In contrast to weight losers, no significant increase in 2-year mortality was observed among the 44 subjects with weight gains of 4% or greater (6/44 died for 13% 2-year mortality).

Logistic and proportional hazards (Cox) regression analyses were performed to further evaluate the association between weight loss and mortality after adjusting for multiple measures of comorbidity (age, BMI, tobacco use, presence of hypertension, diabetes, ischemic heart disease or a history of cancer, SIP scores, self-rated health, cholesterol and albumin levels). Whether entered as a continuous variable (weight percentage change) or as a categorical variable (weight loss ≥ 4%, yes/no), weight loss was found to be the single strongest predictor of subsequent mortality in the regression model

Table 4. Annual Changes in Body Composition and Health Status Measures in Involuntary Weight Losers (During Year of Weight Loss) Compared with Nonweight Losers*

	Involuntary Weight Loser (n = 54)	Nonweight Loser (n = 175)	P Value
Weight (Kg)	−5.6 ± 2.9	+0.3 ± 1.7	<.001
Skinfolds (mm)			
Triceps	−2.6 ± 4.5	−1.4 ± 2.7	.06
Subscapular	−2.9 ± 3.2	−0.4 ± 2.6	<.001
Suprailiac	−4.2 ± 4.2	−0.2 ± 3.1	<.001
Waist/Hip ratio	−0.01 ± .03	+0.00 ± .02	.02
Arm muscle area (cm²)	+0.9 ± 5.6	+2.9 ± 4.1	.02
Albumin (gm/dL)	−0.0 ± 0.3	−0.0 ± 0.2	.77
SIP Score	+1.5 ± 5.1	+0.5 ± 5.0	.24
Self-rated health	−0.1 ± 1.0	−0.1 ± 0.6	.79

* Values are means ± SD. Significance of differences between groups were determined by two-tailed t tests.

Table 5. Health Outcome Measures

Measure	Involuntary Weight Loser (n = 54)	Nonweight Loser (n = 175)	P value*
Hospitalizations: No. of subjects hospitalized during			
Year of weight change	19/54 (35%)	48 /174 (28%)	.28
Year after weight change	18/53 (34%)	54 /174 (31%)	.69
Nursing home placement	0/54	2 /175	.99
Death (2-year mortality)	15/54 (28%)	20 /175 (11%)	.003

* Significance of differences between groups were determined by chi-square tests.

analyses. After adjusting for age, BMI, tobacco use, hypertension, SIP scores, self-rated health, and cholesterol and albumin levels, involuntary weight loss remained significantly associated with increased 2-year mortality (RR = 2.83, 95% CI = 1.38–5.81, P = .004). The prevalences of diabetes, prior history of cancer, and ischemic heart disease were very similar among weight losers and NWL. Addition of these variables to the regression model did not significantly alter the results.

Logistic regression analysis among the 54 IWL subjects indicated that BMI (initially considered as a continuous variable) before weight loss and the degree of weight loss beyond 4% were not significantly associated with subsequent mortality. However, when BMI was broken into quartiles (BMI < 24, BMI 24–27, BMI 27–30, and BMI > 30 kg/m^2), significantly higher mortality was noted among IWL whose initial BMI was <24 kg/m^2 (7 of 12 such subjects expired vs 8 of 42 subjects whose BMI was ≥ 24 kg/m^2, age adjusted RR = 2.96, 95% CI = 1.01–8.67, P = .05). And, although not statistically significant, the lowest mortality rates among weight losers occurred in the nine subjects whose initial BMI was >30 kg/m^2 (1 of 9 expired). In contrast to IWL, no significant increase in mortality was observed among NWL whose BMI was <24 kg/m^2.

Subgroup analysis of mortality rates in all subjects attempting to lose weight by dieting (n = 30) were also performed. The results demonstrated that voluntary weight losers who were "successful" in losing weight (n = 11) had higher mortality rates (4/11, 36%) than persons who were dieting but did not actually sustain any weight loss (2/19, 11%), though this difference did not reach statistical significance (RR = 3.45, 95% CI = 0.75–15.90, P = .16). Still, the higher mortality rates observed among weight losers, regardless of whether weight loss was voluntary (36%) or involuntary (28%), relative to mortality rates among nonweight losers, whether dieting (11%) or not (11%), were remarkably similar.

Cause of Death

The causes of death (n = 15) among involuntary weight losers were: cancer - six (40%), five lung and one prostate cancer; cardiac - six (40%); infections - three (20%); pneumonia - two; acute cholangitis - one. The causes of death (n = 20) among the nonweight losers were: cardiac - eight (40%); cancer - four (20%), three GI and one lung cancer; CNS events - three (15%); Infections - two (10%); miscellaneous - three (15%). Causes of death (n = 4) among voluntary weight losers were: cardiac - three (75%) and other (fall related trauma) - one (25%). The cause of death among subjects dieting but not successful in losing weight (n = 2) was cardiac in both cases (100%). None of the observed differences in proportionate mortality rates were statistically significant.

DISCUSSION

Poor nutrition and weight loss are believed to occur with increasing frequency with aging.[1–9] Yet the parameters for defining clinically important weight changes and their health implications in older persons have not been well described. The range of weight loss cited in the literature as clinically important includes 2 kg a year,[19] 4.5 kg over 2 years,[13] 5% over 6 to 12 months,[11,12] 7.5% over 6 months,[24] and 10% over 6 months.[9,20] Analysis of the association between weight loss and subsequent mortality in this study indicated the optimal cutpoint for defining clinically important weight loss was in the 4 to 5% range. Although 4% was a more sensitive cutpoint, a significant association between weight loss ≥ 5% and mortality was also present, and the 5% definition had somewhat higher specificity and accuracy. Further, the overall study findings and conclusions were similar regardless of whether 4% or 5% was used to define significant weight loss. Although for study purposes we chose the more sensitive 4%

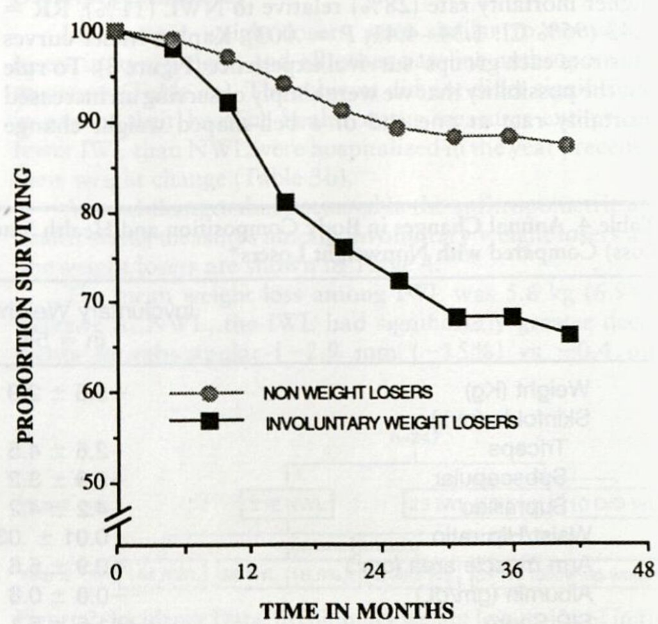

Figure 3. Kaplan-Meier curves comparing survival experience of subjects with and without involuntary weight loss ≥ 4% (P= .003).

definition, for clinical purposes the distinction between weight loss of 4% versus 5% is likely not important. It appeared that the degree of weight loss beyond this threshold was not related to further increases in mortality, suggesting that clinicians should approach patients with a 4% or 5% weight loss similarly to patients with higher degrees of weight loss.

The observed anthropometric changes indicated that subjects with involuntary weight loss had significant decrements in central body fat measures relative to nonweight losers. The changes in body fat patterning among weight losers included a decrease in waist/hip ratios and in the subscapular/triceps skinfold ratio. Although such skinfold and circumference measures may not accurately estimate metabolically important visceral (intra-abdominal) fat stores, they have been shown to be useful descriptive indices that correlate with obesity-related health risks (e.g., insulin resistance and diabetes, hypertension, dyslipidemia) and mortality.[30–32, 37–42] Thus, the decrements in the anthropometric measures of central body fat observed among weight losers might be expected to represent a potentially favorable alteration in body fat patterns.[37–41] These findings are consistent with a previous study by Shimokata et al. that demonstrated similar changes in central fat distribution in men who lost weight.[42] In terms of muscle mass (CAMA) we found no significant changes in arm muscle area among IWL and a small, unexplained increase among NWL. Although arm muscle area has been shown to be a useful measure of malnutrition, with prognostic implications,[43–46] its accuracy as a reliable indicator of total body muscle mass in older persons has not been fully validated.[47,48] While it is possible that the arm muscle measures were insensitive for detecting decreases in total body muscle mass, an alternative explanation is that weight loss occurred primarily from fat stores rather than from lean body mass in these relatively medically stable subjects. Serum albumin levels, a reliable indicator of visceral protein status in older persons,[49] also did not decline among involuntary weight losers. Previous studies conducted primarily in hospitalized and institutionalized patients have indicated that low albumin levels are strongly predictive of increased morbidity and mortality.[49–51] Although low albumin levels were associated with increased mortality in this study (data not shown), weight loss was a stronger predictor of mortality than was albumin, and significant weight loss generally occurred without accompanying declines in albumin levels.

In terms of clinical significance, subjects with weight loss of 4% or greater had significantly higher mortality rates than nonweight losers. One potential explanation for this finding is that patients who lost weight had more pre-existing illness at baseline than nonweight losers. However, there were no significant differences in any of the numerous baseline anthropometric and health status measures to suggest that subjects who went on to lose weight had more pre-existing disease (to the contrary, IWL had fewer hospitalizations than NWL in the year before weight change). Further, relative to NWL, IWL did not have significantly higher health health care utilization nor worsening of SIP and self-rated health measures during the year they lost weight. Although this does not rule out that weight loss was simply a marker of underlying disease, the association between involuntary weight loss and increased mortality also persisted after adjusting for baseline age, BMI, tobacco use, presence of comorbid disease (hypertension, diabetes, history of cancer, ischemic heart disease), and other health status measures (SIP scores, self-rated health, cholesterol and albumin levels). These results are consistent with a study by Sullivan et al., which found weight loss to be a strong independent predictor of mortality after controlling for age, functional status, and numerous other measures of comorbidity.[17] Our results suggesting that weight loss is more strongly associated with increased mortality among thin subjects (initial BMI < 24 kg/m^2) and less strongly associated with increased mortality among obese subjects (initial BMI > 30 kg/m^2) are also consistent with previous reports.[11,23,52]

The mortality rate for involuntary weight losers (28% mortality at 2 years) was lower than rates previously reported for inpatients with weight loss. In a case series of veterans (70% inpatient and 30% outpatient) with weight loss of 5% or greater, Marton et al. reported a 1-year mortality rate of 25%.[11] In an inpatient study, Rabinovitz et al. found a 38% mortality rate at 30 months among subjects with weight loss of 5% or greater.[12] However, our 28% 2-year mortality rate was substantially higher than the 2-year mortality rate of 9% reported in a recent series of ambulatory older persons with unexplained weight loss of 7.5% or greater.[24]

Of note was the finding that similar increases in mortality were observed among weight losers regardless of whether weight loss was classified by the subject as involuntary or voluntary (by dieting). This may indicate that clinicians should be concerned about all patients who lose and maintain weight loss, even those that state they are attempting to lose weight. This is consistent with our knowledge that voluntary maintenance of weight loss is very difficult,[53,54] and, thus, "success" in losing weight may well reflect underlying problems and disease states rather than actual planned weight loss. Alternatively, even if a dieting subject's weight loss was truly volitional such patients may have had more weight-related medical problems (diabetes, hypertension, hyperlipidemia, etc.) and, hence, greater incentive (including more physician advice) to lose weight. Successful voluntary weight loss may have acted as a marker of underlying weight-related illness, thereby accounting for the observed increased mortality rates. However, the possibility that weight loss may be causally related to increased mortality has been raised in other studies.[23,55] It may be that weight loss, whether voluntary or involuntary, has untoward physiologic effects that can lead to increased morbidity and mortality. Potential mechanisms that might be especially relevant in older persons include: weight loss has been associated with impaired immunity and increased susceptibility to infection[56]; any loss of skeletal muscle that might accompany weight loss would be expected to lead to decreased strength and functional status;[57] and weight loss has been associated with decreased bone mass and a possible increase risk of fractures in older women.[58] It is likely that the impact of any adverse physiologic effects of weight loss would be greater in older persons for reasons that include their restricted reserve and decreased ability to compensate when stressed. In considering the biologic plausibility of this hypothesis, it is important to note that there is a lack of strong evidence that weight loss, even among obese middle-aged persons, increases longevity.[21] Further, any potential benefits that weight loss might have on mortality (e.g., through improved insulin resistance, lipid profiles, etc.) would likely be diminished in older persons. Taken together, these factors imply increasing risks and decreasing benefits associated with weight loss with advancing age. If weight loss, in and of itself, is associated with increased mortality, it might significantly alter our approach toward mild to moderately overweight older patients. The small numbers here limit such inferences, but because of the potential implications, this issue should be further studied.

This study has a number of limitations. First, the population studied was relatively small (n = 300) and the participation rates in the primary study were modest. Further, the weight loss analyses were necessarily restricted to the 247 cases who had weight measures available for at least a 1-year period. However, participants and nonparticipants were similar in numerous demographic and health characteristics, and even when the analysis included the 53 cases who were without follow-up weights after entry into the study (assuming no weight loss on an "intention to follow" basis), the overall results and conclusions of the study did not change. Nonetheless, the study cohort was limited to white male veterans, and caution should be exercised in generalizing the incidence and mortality findings to other populations. Next, the use of anthropometric indices rather than more sophisticated techniques such as dual energy X-ray absorptiometry (DEXA) or CT scans to describe changes in body fat and muscle significantly limits the interpretation of any pathophysiologic changes in body fat and muscle that may have accompanied weight loss. Also, recording weights yearly rather than more frequently limited the opportunity to investigate weight fluctuations more closely and to determine whether weight loss was slow and continuous or precipitous and associated with some acute event or disease. Finally, it is important to stress that there are numerous potential explanations for the observed association between weight loss and mortality other than cause and effect. The intent of this study was to evaluate the clinical importance of various degress of weight loss and describe the extent (if any) of the association between weight loss and subsequent morbidity and mortality. While weight loss per se may contribute to increased morbidity and mortality, this study should not be over interpreted in this regard.

To our knowledge this is the first prospective study differentially evaluating unintentional and intentional weight loss in an older outpatient population. The primary goals of this study were to evaluate and describe the incidence, anthropometric parameters, and morbidity and mortality associated with involuntary weight loss. We found that involuntary weight loss of 4% or greater occurred frequently (annual incidence of 13%), was accompanied by significant decrements in skinfold and circumference measures of central body fat, and was associated with two- to threefold increased mortality rates. Similarly increased mortality rates were observed among all weight losers, regardless of whether weight loss was intentional (by dieting) or not. Because of its apparent frequency and association with mortality, we believe weight loss in older persons is a clinically important problem that merits further investigation to better understand its causes and associated pathophysiology.

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REFERENCES

1. Fischer J, Johnson MA. Low body weight and weight loss in the aged. J Am Diet Assoc 1990;90:1697–1706.
2. Manson A, Shea S. Malnutrition in elderly ambulatory medical patients. Am J Public Health 1991;81:1195–1197.
3. Morley JE. Nutritional status of the elderly. Am J Med 1986;81:679–695.
4. Mitchell CO, Lipschitz DA. Detection of protein-calorie malnutrition in the elderly. Am J Clin Nutr 1982;35:398–406.
5. Dwyer JT, Campbell D, eds. Screening Older American's Nutritional Health: Current Practices and Future Possibilities. Nutrition Screening Initiative. Washington DC, 1991.
6. Olsen-Nell CG, Bosworth MF. Anorexia and weight loss in the elderly. Postgrad Med 1989;85:140–144.
7. Verdery RB Fatigue, Failure to thrive, weight loss and cachexia. In: Hazzard WR, Andres R, Bickman EL, Blass JP, eds. Principles of Geriatric Medicine; 2nd Ed. New York: McGraw-Hill, 1990, pp 1102–1108.
8. Miller DK, Morley JE, Rubenstein LZ et al. Formal geriatric assessment instruments and the care of older general medical outpatients. J Am Geriatr Soc 1990;38:645–651.
9. Morley JE, Mooradian AD, Silver AJ et al. Nutrition in the elderly. Ann Intern Med 1988;109:890–904.
10. Rudman D, Feller AG. Protein-calorie undernutrition in the nursing home. J Am Geriatr Soc 1989;37:173–183.
11. Marton KI, Sox HC, Krupp JR. Involuntary weight loss: Diagnostic and prognostic significance. Ann Intern Med 1981;95:568–574.
12. Rabinovitz M, Pitlik SD, Leifer M et al. Unintentional weight loss. Arch Intern Med 1986;146:186–187.
13. Dwyer JT, Coleman A, Krall E et al. Changes in relative weight among institutionalized elderly adults. J Gerontol 1987;42:246–251.
14. Constans T, Bacq Y, Brechot JF et al Protein-energy malnutrition in elderly medical patients. J Am Geriatr Soc 1992;40:263–268.
15. Pinchofsky-Devin GD, Kaminski MW. Correlation of pressure sores and nutritional status. J Am Geriatr Soc 1986;34:435–440.
16. Sullivan DH, Patch GA, Walls RC et al. Impact of nutrition status on morbidity and mortality in a select population of geriatric rehabilitation patients. Am J Clin Nutr 1990;51:749–758.
17. Sullivan DH, Walls RC, Lipschitz DA. Protein-energy undernutrition and the risk of mortality within 1 year of hospital discharge in a select population of geriatric rehabilitation patients. Am J Clin Nutr 1991;53:599–605.
18. Harris T, Cook EF, Garrison R et al. Body mass index and mortality among nonsmoking older persons. JAMA 1988;259:1520–1524.
19. Rajala SA, Kanto AJ, Haavisto MV et al. Body weight and the three year prognosis in very old people. Int J Obesity 1990;14:997–1003.
20. Huerta G, Viniegra L. Involuntary weight loss as a clinical problem. Rev Invest Clin (in Spanish) 1989;41:5–9.
21. Williamson DF, Pamuk ER. The association between weight loss and increased longevity: A review of the evidence. Ann Intern Med 1993;119:731–736.
22. Andres R, Muller DC, Sorkin JD. Long-term effects of change in body weight on all-cause mortality: A review. Ann Intern Med 1993;119:737–743.
23. Pamuk ER, Williamson DF, Serdula MK et al. Weight loss and subsequent death in a cohort of U.S. adults. Ann Intern Med 1993;119:744–748.
24. Thompson MP, Morris LK. Unexplained weight loss in the ambulatory elderly. J Am Geriatr Soc 1991;39:497–500.
25. Bergner M, Bobbit RA, Pollard WE et al. The Sickness Impact Profile: Validation of a health status measure. Med Care 1976;14:56–67.
26. Vir SC, Love AHG. Anthropometric measurements in the elderly. Gerontology 1980;26:1–8.
27. Pollock ML, Jackson AS. Research progress in validation of clinical methods of assessing body composition. Med Sci Sports Exerc 1984;16:606–613.
28. Garrow JS, Webster J. Quetelet's Index (W/H2) as a measure of fatness. Int J Obesity 1985;9:147–153.
29. Russell RM, Sahyoun NR, Whinston-Perry R. Nutritional assessment. In: Calkins E, ed. The Practice of Geriatrics. Philadelphia: WB Saunders, 1986, pp 135–145.
30. Martin AD, Ross WD, Drinkwater DT, Clarys JP. Prediction of body fat by skinfold caliper: Assumptions and cadaver evidence. Int J Obesity 1985;9:31–39.
31. Shimokata H, Tobin JD, Muller DC et al. Studies in the distribution of body fat. I. Effects of age, sex and obesity. J Gerontol 1989;44:M66–73.
32. Björntorp P. Regional patterns of fat distribution. Ann Intern Med 1989;103:994–995.
33. Heymsfield SB, McManus C, StevensV, Smith J. Muscle mass: Reliable indicator of protein-energy malnutrition severity and outcome. Am J Clin Nutr

1982;35:1192–1199.
34. Anderson CF, Wochos DN. The utility of serum albumin values in the nutritional assessment of hospitalized patients. Mayo Clin Proc 1982;57:181–184.
35. Robbins LJ. Evaluation of weight loss in the elderly. Geriatrics 1989;44:31–37.
36. McNeil BJ, Hanley JA. Statistical approaches to the analysis of receiver operating characteristic (ROC) curves. Med Decis Making 1984;4:137–150.
37. Björntorp P. The associations between obesity, adipose tissue distribution and disease. Acta Med Scand 1988;723 (Suppl):121–134.
38. Seidell JC, Cigolini M, Charzewska J et al. Fat distribution in European men: A comparison of anthropometric measurements in relation to cardiovascular risk factors. Int J Obesity 1992;16:17–22.
39. Ostlund RE, Staten M, Kohrt WM et al. The ratio of waist-to-hip circumference, plasma insulin level, and glucose intolerance as independent predictors of the HDL cholesterol level in older adults. N Engl J Med 1990;322:229–234.
40. Larsson B. Regional obesity as a health hazard in men. Act Med Scand 1988;723:45–51.
41. Bouchard C, Bray GA, Hubbard VS. Basic and clinical aspects of regional fat distribution. Am J Clin Nutr 1990;52:946–950.
42. Shimokata H, Andres R, Coon PJ et al. Studies in the distribution of body fat. II. Longitudinal effects of change in weight. Int J Obesity 1989;13:455–464.
43. Heymsfield SB, McManus C, Smith J et al. Anthropometric measurement of muscle mass. Am J Clin Nutr 1982;36:680–690.
44. Friedmand PJ, Campbell AJ, Caradoc-Davies TH. Prospective trial of a new diagnostic criterion for severe wasting malnutrition in the elderly. Age Ageing 1985;14:149–154.
45. Friedman PJ. A prospective comparison of methods to identify lethal wasting malnutrition. Nutr Res 1986;6:139–146.
46. Campbell AJ, Spears GR, Brown JS et al. Anthropometric measurements as predictors of mortality in a community population aged 70 years and over. Age Ageing 1990;19:131–135.
47. Kuczmarski RJ. Need for body composition information in elderly subjects. Am J Clin Nutr 1989;50:1150–1157.
48. Katch FI, Hortobagyi T. Validity of surface anthropometry to estimate upper-arm muscularity, including changes with body mass loss. Am J Clin Nutr 1990;52:591–595.
49. Mobarhan S, Trumbore LS. Nutritional problems of the elderly. Clin Geriatr Med 1991;7:191–214.
50. Agarwal N, Acevedo F, Leighton LS et al. Predictive ability of various nutritional variables for mortality in elderly people. Am J Clin Nutr 1988;48:1173–1178.
51. Herrman FR, Safran C, Levkoff SE, Minaker KL. Serum albumin level on admission as a predictor of death, length of stay, and readmisssion. Arch Intern Med 1992;152:125–130.
52. Kuller L, Wing R. Weight loss and mortality. Ann Intern Med 1993;119:630–632.
53. Blackburn GC, Wilson GT, Kanders BS et al. Weight cycling: The experience of human dieters. Am J Clin Nutr 1989;49:1105–1109.
54. NIH Technology Assessment Conference Panel. Methods for voluntary weight loss and control. Ann Intern Med 1992;116:942–949.
55. Lee IM, Paffenbarger RS Jr. Change in body weight and longevity. JAMA 1992;268:2045–2049.
56. Grimes CJC, Younathon MT, Lee WC. The effect of preoperative total parenteral nutrition on surgery outcomes. J Am Diet Assoc 1987;87:1202–1205.
57. Buchner DM deLateur BJ. The importance of skeletal muscle strength to physical function in older adults. Ann Behav Med 1991;13:91–98.
58. Bauer DC, Browner W, Cauley JA et al. Factors associated with appendicular bone mass in older women. Ann Intern Med 1993;118:657–665.