

Citation:

Volpato S, Romagnoni F, Soattin L, Blè A, Leoci V, Bollini C, Fellin R, Zuliani G. Body mass index, body cell mass, and 4-year all-cause mortality risk in older nursing home residents. *J Am Geriatr Soc*. 2004 Jun;52(6):886-91.

PubMed ID: [15161451](#)

Study Design:

Prospective Cohort Study

Class:

B - [Click here](#) for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To examine the relationship between body composition, assessed using body mass index (BMI) and body cell mass (BCM), and 4-year all-cause mortality in older nursing home residents.

Inclusion Criteria:

- Nursing home resident for at least 2 months
- Aged 65 and older
- No acute illness at the time of observation or in previous 30 days

Exclusion Criteria:

- Terminal patients with cancer or end-stage liver or renal disease

Description of Study Protocol:**Recruitment**

Residents of the Istituto di Riposo per Anziani nursing home in Padova, Italy were recruited in 1990. Informed consent was obtained from participants.

Design: Prospective cohort study

Blinding used (if applicable): Not applicable

Intervention (if applicable): Not applicable

Statistical Analysis

- Baseline characteristics of participants were compared according to sex-specific tertiles of

BMI. Analysis of variance was used to compare means of continuous measures; whereas the Chi-square test was used to evaluate differences in categorical measures. Survival analysis was conducted using Kaplan-Meier curves and multivariate Cox proportional hazards models.

- Three statistical models were used:
 - Separate analyses for both BMI and BCM adjusting for age, sex, and height
 - Inclusion of BMI and BCM simultaneously in the model adjusting for age, sex, and height
 - The second model plus additional adjustments for smoking, number of diseases, Katz index (assessment of functional status), dementia, depression, albumin level, and blood urea nitrogen/creatinine ratio. Cross-product terms were used to test for interactions between BMI and BCM and BMI or BCM and sex within the models.
- STATA was used to perform the analyses.

Data Collection Summary:

Timing of Measurements

Anthropometric (BMI and BCM), nutritional, and metabolic parameters were obtained at baseline. This paper does not describe or report on the nutritional parameters that were examined in the study.

Dependent Variables

- All-cause mortality was determined using nursing home medical records or follow-up interviews with proxies for residents who had moved (n=9). Up to 4 years of follow-up data was available.

Independent Variables

- Body mass index (BMI): Calculated using measured height and weight (kg/m^2).
- Body cell mass (BCM): Tetrapolar bioelectric impedance (BIA) was used to assess body composition. Measurements were obtained after 20 minutes of rest.

Control Variables

- Age
- Sex
- Height
- Smoking
- Dementia
- Depression
- Blood urea nitrogen/creatinine ratio
- Blood samples were obtained after a 12-hour overnight fast to assess for total cholesterol, high-density lipoprotein, albumin, hemoglobin and creatinine.
- Functional status was determined using the Katz index which takes into account functional level in feeding, continence, mobility, going to the toilet, dressing, and bathing.
- Chronic medical conditions and medications were also obtained from multiple sources of information: baseline interview, medical records, physical examination, current medication list, and blood test results.

Description of Actual Data Sample:

Initial N: 344 (272 females, 72 males) out of 410 residents in the nursing home.

Attrition (final N): 344 (272 females, 72 males); 179 deaths occurred during the 3.5 year follow-up period

Age: Mean age was 82.2 years (range 65-99)

Ethnicity: Italian

Other relevant demographics: At baseline, all subjects were non-smokers.

Anthropometrics: BMI and BCM were analyzed according to three-level variables by sex. BMI cutoffs were 21.6 kg/m² and 25.6 kg/m² for men and 22.0 kg/m² and 25.4 kg/m² for women. BCM cutoffs were 17.7 kg and 21.6 kg for men and 12.4 kg and 14.5 kg for women.

Location: Nursing home in Padua, Italy

Summary of Results:

Key Findings:

- Subjects with low BMI and low BCM (lowest sex-specific tertiles) had significantly higher mortality compared to subjects with higher BMI or BCM levels.
- There was a positive, statistically significant correlation between BMI and BCM ($r=0.45$; $P<0.0001$).
- Mortality risk was significantly lower for subjects in the highest tertile of both BMI and BCM ($P<0.0001$).
- In the fully adjusted regression model, there was a strong and significant inverse association between BCM levels and mortality (RR for tertile III=0.55, 95% CI=0.35-0.87; $P<0.01$).

Unadjusted death rates and adjusted relative risks of all-cause mortality by baseline body mass index (BMI) and body cell mass (BCM) tertiles

Tertile	N	Deaths	Unadjusted Rate (1,000 person years)	Model 1*	Model 2**	Model 3***
BMI						
I	114	76	272.6	1	1	1
II	113	52	164.7	0.59	0.70	0.72
				(0.41-0.85)	(0.48-1.03)	(0.49-1.06)
III	117	51	152.3	0.61	0.88	0.94
				(0.43-0.88)	(0.58-1.35)	(0.61-1.43)
BCM						
I	116	81	311.2	1	1	1

II	110	52	173.7	0.64 (0.44-0.93)	0.71 (0.48-1.04)	0.93 (0.61-1.40)
III	118	46	120.9	0.44 (0.30-0.65)	0.47 (0.30-0.73)	0.55 (0.35-0.87)

* Model 1: BMI and BCM included separately, adjusted for age, sex, and height.

**Model 2: BMI and BCM simultaneously included and adjusted for age, sex, and height.

***Model 3: BMI and BCM simultaneously included, adjusted for age, sex, height, smoking, number of diseases, Katz index, dementia, depression, albumin level, and blood urea nitrogen/creatinine ratio.

Author Conclusion:

Body cell mass (BCM) is a powerful predictor of mortality in older nursing home residents and may provide more useful information to clinicians than body mass index (BMI). In clinical settings, bioelectric impedance is an inexpensive, noninvasive standardized method for assessing BCM.

Reviewer Comments:

Limitations of the study include:

- Only 4 years of follow-up
- Indirect measurements of BCM using BIA which could have been affected by age, sex, and hydration status and led to over- or underestimation of body compartments
- No direct assessment of muscle mass, physical activity or recent weight loss
- Limited generalizability of findings.

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	N/A
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	N/A

Validity Questions

1.	Was the research question clearly stated?	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	Was the selection of study subjects/patients free from bias?	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	No
3.	Were study groups comparable?	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	Yes
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	Was method of handling withdrawals described?	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes

4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	Yes
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	Was blinding used to prevent introduction of bias?	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	Yes
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	Yes
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were intervening factors described?	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	Were outcomes clearly defined and the measurements valid and reliable?	Yes

7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	Was the statistical analysis appropriate for the study design and type of outcome indicators?	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	Are conclusions supported by results with biases and limitations taken into consideration?	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	Is bias due to study's funding or sponsorship unlikely?	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes

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