

Citation:

Allison DB, Gallagher D, Heo M, Pi-Sunyer FX, Heymsfield SB. Body mass index and all-cause mortality among people age 70 and over: the Longitudinal Study of Aging. *Int J Obes Relat Metab Disord*. 1997;21(6):424-31.

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Study Design:

Prospective Longitudinal Cohort Study

Class:

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

Research Design and Implementation Rating:

NEUTRAL: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To assess the relationship between body mass index (BMI; kg/m²) and mortality in a large nationally representative sample of US adults over age 70 years.

Inclusion Criteria:

- Both men and women
- Substantial numbers of blacks and whites
- Relatively advanced age (all subjects 70 y of age).

Exclusion Criteria:

Excluded subjects in apparently ill health.

Description of Study Protocol:**Recruitment**

- A total of 7541 people age 70 y and over were interviewed in their homes during 1984. The subjects in this study include all those persons interviewed in 1984 for whom height and weight were available, 7397 in total (2829 men, 4568 women).
- Only subjects who defined themselves as black and white were used in this study, since there were so relatively few subjects of the other race; which resulted in the total sample size of 7260 (2769 men and 4491 women).

Design

- Prospective longitudinal cohort study. Subjects include both males and females; black and whites of age 70 and over. These subjects were then surveyed again in 1986, 1988, and 1990.
- The later surveys used computer assisted telephone interviews and mailed questionnaires. Information assessed includes

selected lifestyle and demographic information, numerous questions about health and disease, cause and date of death for any subjects dying during the study (obtained by record matching to the National Death Index), and height and weight at entry.

Blinding used (if applicable): not applicable

Intervention (if applicable): not applicable

Statistical Analysis

- The primary statistical analysis consisted of (unweighted) Cox proportional hazard regression with time to death from the initial interview as the end point.
- The independent variable (BMI) and potential confounders were entered into the model as continuous variables or dichotomous variables.
- Higher order power polynomials of BMI were included to represent curved effects if they were statistically significant.
- Because sex, age, and race are often found to be associated with both BMI and longevity, they were selected as potential covariates in the model.
- In order to estimate the BMI associated with minimum mortality, the first derivative of the fitted functions was taken with respect to BMI. This derivative was then set equal to zero and BMI was solved for.

Data Collection Summary:

Timing of Measurements

1984, 1986, 1988, and 1990

Dependent Variables

- Mortality

Independent Variables

- Body mass index based on self-reported height and weight

Control Variables

- Sex
- Race
- Age
- Income
- Education

Description of Actual Data Sample:

Initial N: 7397 in total (2829 men, 4568 women)

Attrition (final N): 7260 (2769 men and 4491 women)

Age: 70 y and over

Ethnicity: Blacks and whites

Other relevant demographics: not reported

Anthropometrics

Location: US noninstitutionalized civilian population.

Summary of Results:

Key Findings

- Race (Black or White) was not statistically significant either, and moreover, its deletion did not affect the BMI and BMI² coefficients by more than 10%, it was not retained.
- Of 2325 people over age 70 who responded to a question about smoking, 23% reported themselves to be current smokers. These smokers had a mean BMI of 23.6 (s.d.=4.4) compared to a mean BMI of 25.1 (s.d.=4.2) for nonsmokers.
- The age by BMI terms were not significant and their deletion did not affect the BMI and BMI² coefficients by more than 10% and they were therefore deleted.
- For the income and education variables, only education met the criteria for being retained in the model.
- Number of living relatives was also tried as a predictor but did not meet criteria for inclusion in the model. Indicators of pre-existing health problems were all highly statistically significant. Interaction terms between these health indicators and BMI terms were tried but did not meet criteria for entry in the model.
- The relationship between BMI and mortality, represented by the hazard ratios, is U-shaped for both men and women.
- The minimum mortality was estimated in the 9th decile of BMI; which reflects relationship between BMI and mortality two models provide nearly identical estimates of risk
- for BMIs between 17 and 38 for women and 18 and 35 for men. These ranges encompass 95.8 and 96.8% of the female and male samples, respectively. This BMI inverse model was refit by excluding ill subjects.
- The results of these analyses suggest that among people aged seventy years and older, the lowest all-cause mortality occurs at a BMI in the low 30s for women and high 20s for men.

Author Conclusion:

- The finding of the relatively high BMI (27±30 for men, 30±35 for women) associated with minimum hazard in persons older than seventy years and, if confirmed in future research, has implications for public health and clinical recommendations.
- Similar prospective studies using better measures of body composition than BMI, oversampling the extremes of BMI to get a better appraisal of the effects of these extreme weights, assessing weight and weight change simultaneously in dynamic statistical models, and assessing cause specific mortality.

Reviewer Comments:

- *This is a longitudinal and a representative sample of U.S. non institutionalized civilian population. Sample size is very large.*
- *Subjects with apparently ill health were excluded in an attempt to reduce the potential confounding effect of pre-existing ill health on survival*
- *Investigators and data collectors were not blinded for outcomes assessments.*
- *Height and weights are self-reported so there may be a bias and other confounding factors like family history and diet may influence the results. Body composition may be helpful to predict all cause mortality among elderly subjects.*

- *Body weight was available at only one time point*
- *The study is in only aged population hence an age distribution study is required to study the obesity markers and confounding factors on all-cause mortality.*

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

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|------|---|-----|
| 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? | Yes |
| 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 |

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| 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? | N/A |
| 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? | No |
| 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.) | No |
| 5.3. | In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded? | No |
| 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 |

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| 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? | No |
| 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? | No |
| 7.5. | Was the measurement of effect at an appropriate level of precision? | ??? |
| 7.6. | Were other factors accounted for (measured) that could affect outcomes? | Yes |
| 7.7. | Were the measurements conducted consistently across groups? | ??? |
| 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 |

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| 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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