**Sedlmeier *et al.;* Relation of body fat mass and fat-free mass to total mortality – results from seven prospective cohort studies;**

**Online Supplementary Material: Supplementary Figures and Tables**



Supplementary Figure 1: Flow chart of the pooled study population.



Supplementary Figure 2: Fixed-effects meta-analysis of hazard ratios (HRs) of total mortality for the highest vs. intermediate to low fat mass index (4th quartile vs. 2nd quartile). The black square and the respective line represent the HR and the corresponding 95% confidence interval (CI) for each study. The diamond represents the summary HR with the corresponding 95% CI for fat mass index and total mortality. P: P value; I2: heterogeneity among cohorts.



Supplementary Figure 3: Fixed-effects meta-analysis of hazard ratios (HRs) of total mortality for the highest vs. lowest fat-free mass index (4th quartile vs. 1st quartile). The black square and the respective line represent the HR and the corresponding 95% confidence interval (CI) for each study. The diamond represents the summary HR with the corresponding 95% CI for fat-free mass index and total mortality. P: P value; I2: heterogeneity among cohorts.

Supplementary Table 1: Number of participants, cases, person-years, and median follow-up years in KORA 1994/1995, KORA 1999/2001, NHANES 1999/2000, NHANES 2001/2002, NHANES 2003/2004, SHIP-2 2008/2012, and SHIP-Trend 2008/2012 cohorts.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Cohort** | **Number of participants (n)** | **Number of cases (n)** | **Person-years** | **Median follow-up years** |
|  | Total | Men | Women | Total | Men | Women |  |  |
| KORA 1994/1995 | 3,446 | 1,736 | 1,710 | 701 | 444 | 257 | 66,918 | 21.0 |
| KORA 1999/2001 | 3,697 | 1,805 | 1,892 | 409 | 247 | 162 | 55,630 | 15.7 |
| NHANES 1999/2000 | 1,270 | 663 | 607 | 59 | 36 | 23 | 19,716 | 15.8 |
| NHANES 2001/2002 | 1,477 | 781 | 696 | 79 | 49 | 30 | 20,200 | 14.0 |
| NHANES 2003/2004 | 1,327 | 731 | 596 | 42 | 27 | 15 | 15,620 | 11.8 |
| SHIP-2 2008/2012 | 1,522 | 697 | 825 | 29 | 21 | 8 | 4,491 | 3.0 |
| SHIP-Trend 2008/2012 | 3,416 | 1,620 | 1,796 | 28 | 24 | 4 | 9,982 | 2.8 |
| **Total** | 16,155 | 8,033 | 8,122 | 1,347 | 848 | 499 | 192,557 | 14.3 |

KORA: Cooperative Health Research in the Region Augsburg; NHANES: U.S. National Health and Nutrition Examination Survey; SHIP: Study of Health in Pomerania.

Supplementary Table 2: Age-standardized baseline characteristics of participants according to sex-specific quartiles of fat mass index and fat-free mass index in KORA 1994/1995 (n=3,446)1.

|  |  |  |
| --- | --- | --- |
|  | **Fat mass index** | **Fat-free mass index** |
| Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
|  | Mean (SD) or % | Mean (SD) or % |
| No. (%) | 864 (25.1) | 865 (25.1) | 857 (24.9) | 860 (25.0) | 869 (25.2) | 860 (25.0) | 858 (24.9) | 859 (24.9) |
| Age (years)  | 39.3 (11.3) | 47.7 (13.4) | 51.6 (12.8) | 54.4 (12.2) | 43.7 (14.1) | 47.7 (13.8) | 50.1 (13.3) | 51.6 (12.1) |
| **Sex (%)** |  |  |  |  |  |  |  |  |
| Men | 54.2 | 50.7 | 51.9 | 50.4 | 51.8 | 50.3 | 50.3 | 51.7 |
| Women | 45.8 | 49.3 | 48.1 | 49.6 | 48.2 | 49.7 | 49.7 | 48.3 |
| **Anthropometric variables** |  |  |  |  |  |  |  |  |
| Fat mass index (kg/m2)  | 5.5 (1.1) | 7.4 (1.0) | 9.1 (1.3) | 12.5 (2.8) | 6.6 (2.2) | 7.7 (2.4) | 8.8 (2.9) | 11.4 (4.4) |
| Fat-free mass index (kg/m2) | 16.9 (2.1) | 17.7 (2.0) | 18.4 (1.9) | 20.2 (2.1) | 16.3 (1.8) | 17.5 (1.7) | 18.6 (1.8) | 20.6 (2.3) |
| Body mass index (kg/m2)  | 22.4 (1.9) | 25.1 (1.6) | 27.5 (1.4) | 32.6 (3.4) | 22.8 (2.4) | 25.2 (2.4) | 27.4 (2.7) | 32.0 (4.4) |
| Body fat mass (kg) | 15.5 (2.8) | 20.9 (2.2) | 25.7 (2.7) | 34.8 (7.0) | 18.9 (6.1) | 21.8 (6.5) | 24.4 (7.9) | 31.5 (12.0) |
| Body weight (kg) | 63.9 (9.4) | 71.3 (9.7) | 78.6 (9.3) | 91.9 (12.2) | 66.2 (11.0) | 72.1 (11.3) | 77.0 (12.2) | 89.2 (15.6) |
| **Ethnicity (%)** |  |  |  |  |  |  |  |  |
| Non-Hispanic White | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| **Education (%)2** |  |  |  |  |  |  |  |  |
| Low | 47.8 | 55.0 | 61.1 | 68.9 | 48.3 | 54.3 | 62.4 | 68.7 |
| High | 52.2 | 45.0 | 38.9 | 31.1 | 51.7 | 45.7 | 37.6 | 31.3 |
| **Physical activity (%)** |  |  |  |  |  |  |  |  |
| No physical activity  | 44.8 | 50.9 | 57.1 | 66.3 | 53.9 | 51.5 | 52.6 | 61.5 |
| Physical activity | 55.2 | 49.1 | 42.9 | 33.7 | 46.1 | 48.5 | 47.4 | 38.5 |
| **Smoking (%)** |  |  |  |  |  |  |  |  |
| Never  | 37.7 | 44.8 | 44.7 | 43.8 | 37.6 | 44.5 | 45.2 | 45.2 |
| Former  | 29 | 27.1 | 29.4 | 31.5 | 30.0 | 27.9 | 29.3 | 29.8 |
| Current  | 33.2 | 28.1 | 26 | 24.7 | 32.4 | 27.6 | 25.5 | 25.0 |
| **Alcohol intake (g/d)**  | 18.6 (22.9) | 17.7 (22.6) | 18.1 (23.9) | 14.7 (21.3) | 19.0 (19.5) | 17.2 (19.0) | 16.5 (17.7) | 15.5 (15.9) |
| **Diabetes mellitus (%)**  | 3.1 | 2.6 | 2.8 | 4.9 | 2.9 | 2.4 | 3.4 | 4.2 |

KORA: Cooperative Health Research in the Region Augsburg.

1 Age-standardization was obtained via direct standardization to the baseline age distribution of the analytic cohort. Sex-specific quartiles of fat mass index were defined by their distribution (25th quantile, median, 75th quantile); for men: 25th quantile=5.94 kg/m2, median=7.22 kg/m2, 75th quantile=8.87 kg/m2; for women: 25th quantile=7.27 kg/m2, median=9.22 kg/m2, 75th quantile=11.58 kg/m2.

Sex-specific quartiles of fat-free mass index were defined by their distribution (25th quantile, median, 75th quantile); for men: 25th quantile=18.57 kg/m2, median=19.64 kg/m2, 75th quantile=20.77 kg/m2; for women: 25th quantile=15.43 kg/m2, median=16.41 kg/m2, 75th quantile=17.69 kg/m2.

2 Low education is defined as ≤10 years of education for KORA and SHIP or “<9th Grade/9-11th Grade/High School Graduate/GED or Equivalent” for NHANES. High education is defined as >10 years of education for KORA and SHIP or “Some College or AA degree/College Graduate or above” for NHANES.

Supplementary Table 3: Age-standardized baseline characteristics of participants according to sex-specific quartiles of fat mass index and fat-free mass index in KORA 1999/2001 (n=3,697)1.

|  |  |  |
| --- | --- | --- |
|  | **Fat mass index** | **Fat-free mass index** |
| Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
|   | Mean (SD) or % | Mean (SD) or % |
| No. (%) | 930 (25.2) | 923 (25.0) | 920 (24.9) | 924 (25.0) | 934 (25.3) | 923 (25.0) | 918 (24.8) | 922 (24.9) |
| Age (years)  | 40.4 (11.4) | 46.5 (12.7) | 51.2 (13.4) | 54.1 (12.8) | 44.3 (13.7) | 46.8 (13.5) | 49.7 (13.4) | 51.5 (12.7) |
| **Sex (%)** |  |  |  |  |  |  |  |  |
| Men | 51.1 | 48.9 | 49.2 | 49.0 | 49.9 | 49.1 | 48.9 | 49.4 |
| Women | 48.9 | 51.1 | 50.8 | 51.0 | 50.1 | 50.9 | 51.1 | 50.6 |
| **Anthropometric variables** |  |  |  |  |  |  |  |  |
| Fat mass index (kg/m2)  | 5.6 (1.1) | 7.6 (1.0) | 9.4 (1.4) | 12.9 (2.8) | 6.6 (1.6) | 7.8 (1.9) | 9.1 (2.1) | 11.9 (3.4) |
| Fat-free mass index (kg/m2) | 16.6 (2.1) | 17.5 (2.0) | 18.4 (1.9) | 20.2 (2.1) | 16.1 (1.7) | 17.4 (1.6) | 18.5 (1.6) | 20.6 (1.9) |
| Body mass index (kg/m2)  | 22.2 (1.9) | 25.1 (1.5) | 27.9 (1.5) | 33.1 (3.5) | 22.7 (2.0) | 25.3 (1.8) | 27.6 (1.9) | 32.6 (3.8) |
| Body fat mass (kg) | 15.8 (2.8) | 21.4 (2.2) | 26.7 (3.1) | 36.1 (7.3) | 19.0 (4.7) | 22.3 (5.2) | 25.3 (5.7) | 33.1 (9.2) |
| Body weight (kg) | 63.7 (9.8) | 71.7 (9.7) | 79.5 (9.5) | 93.7 (13.3) | 66.0 (10.9) | 72.6 (10.9) | 77.9 (10.9) | 91.4 (14.0) |
| **Ethnicity (%)** |  |  |  |  |  |  |  |  |
| Non-Hispanic White | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| **Education (%)2** |  |  |  |  |  |  |  |  |
| Low | 41.9 | 42.8 | 48.4 | 53.8 | 38.4 | 42.1 | 49.4 | 55.2 |
| High | 58.1 | 57.2 | 51.6 | 46.2 | 61.6 | 57.9 | 50.6 | 44.8 |
| **Physical activity (%)** |  |  |  |  |  |  |  |  |
| No physical activity  | 42.3 | 45.1 | 51.9 | 61.7 | 47.1 | 46.4 | 50.3 | 57.1 |
| Physical activity | 57.7 | 54.9 | 48.1 | 38.3 | 52.9 | 53.6 | 49.7 | 42.9 |
| **Smoking (%)** |  |  |  |  |  |  |  |  |
| Never  | 40.0 | 41.5 | 41.0 | 42.4 | 39.9 | 40.4 | 42.1 | 42.7 |
| Former  | 26.8 | 31.7 | 32.6 | 34.1 | 28.5 | 33.4 | 31.1 | 32.9 |
| Current  | 33.2 | 26.8 | 26.4 | 23.5 | 31.7 | 26.2 | 26.7 | 24.4 |
| **Alcohol intake (g/d)**  | 15.5 (19.8) | 15.9 (18.9) | 16.9 (22.9) | 15.1 (23) | 15.8 (20.6) | 16.8 (20.5) | 16.5 (22.1) | 15.3 (22.2) |
| **Diabetes mellitus (%)** | 1.2 | 1.6 | 2.7 | 5.6 | 0.5 | 2.8 | 2.5 | 5.7 |

KORA: Cooperative Health Research in the Region Augsburg.

1 Age-standardization was obtained via direct standardization to the baseline age distribution of the analytic cohort. Sex-specific quartiles of fat mass index were defined by their distribution (25th quantile, median, 75th quantile); for men: 25th quantile=5.96 kg/m2, median=7.38 kg/m2, 75th quantile=8.97 kg/m2; for women: 25th quantile=7.45 kg/m2, median=9.45 kg/m2, 75th quantile=12.04 kg/m2.

Sex-specific quartiles of fat-free mass index were defined by their distribution (25th quantile, median, 75th quantile); for men: 25th quantile=18.58 kg/m2, median=19.55 kg/m2, 75th quantile=20.70 kg/m2; for women: 25th quantile=15.31 kg/m2, median=16.36 kg/m2, 75th quantile=17.72 kg/m2.

2 Low education is defined as ≤10 years of education for KORA and SHIP or “<9th Grade/9-11th Grade/High School Graduate/GED or Equivalent” for NHANES. High education is defined as >10 years of education for KORA and SHIP or “Some College or AA degree/College Graduate or above” for NHANES.

Supplementary Table 4: Age-standardized baseline characteristics of participants according to sex-specific quartiles of fat mass index and fat-free mass index in NHANES 1999/2000 (n=1,270)1.

|  |  |  |
| --- | --- | --- |
|  | **Fat mass index** | **Fat-free mass index** |
| Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
|  | Mean (SD) or % | Mean (SD) or % |
| No. (%) | 330 (26.0) | 307 (24.2) | 320 (25.2) | 313 (24.6) | 325 (25.6) | 314 (24.7) | 323 (25.4) | 308 (24.3) |
| Age (years)  | 32.1 (8.6) | 34.9 (8.5) | 36.2 (7.9) | 35.7 (8.7) | 33.8 (8.9) | 34.8 (8.8) | 35.1 (8.4) | 35.1 (8.2) |
| **Sex (%)** |  |  |  |  |  |  |  |  |
| Men | 48.7 | 53.8 | 53.1 | 51.5 | 51.0 | 53.4 | 53.5 | 51.9 |
| Women | 51.3 | 46.2 | 46.9 | 48.5 | 49.0 | 46.6 | 46.5 | 48.1 |
| **Anthropometric variables** |  |  |  |  |  |  |  |  |
| Fat mass index (kg/m2)  | 5.4 (2.0) | 7.5 (2.0) | 9.6 (2.6) | 13.8 (3.9) | 7.3 (2.7) | 8.0 (3.1) | 9.3 (3.9) | 11.6 (5.2) |
| Fat-free mass index (kg/m2) | 17.0 (3.3) | 17.6 (3.2) | 18.5 (3.2) | 20.7 (3.0) | 15.0 (1.8) | 17.3 (2.0) | 19.2 (2.1) | 22.6 (2.4) |
| Body mass index (kg/m2)  | 22.5 (2.7) | 25.0 (2.6) | 28.2 (3.1) | 34.5 (4.7) | 22.3 (2.6) | 25.2 (2.7) | 28.5 (3.4) | 34.3 (4.9) |
| Body fat mass (kg) | 14.9 (5.2) | 20.9 (4.6) | 26.8 (5.7) | 39.3 (10.6) | 20.6 (7.3) | 22.3 (8.1) | 25.9 (10.4) | 32.6 (14.6) |
| Body weight (kg) | 63.5 (11.5) | 71.6 (11.3) | 80.1 (11.6) | 98.7 (16.1) | 63.5 (10.8) | 71.6 (10.9) | 81.3 (12.9) | 97.8 (16.9) |
| **Ethnicity (%)** |  |  |  |  |  |  |  |  |
| Mexican American | 17.7 | 29.2 | 35.6 | 34.0 | 27.2 | 29.1 | 31.4 | 28.3 |
| Other Hispanic | 7.5 | 6.0 | 9.3 | 5.5 | 5.1 | 7.4 | 9.8 | 6.9 |
| Non-Hispanic White | 54.3 | 43.9 | 38.0 | 30.9 | 45.3 | 43.8 | 38.9 | 36.6 |
| Non-Hispanic Black | 17.0 | 16.7 | 15.9 | 25.8 | 17.9 | 15.8 | 17.8 | 25.5 |
| Other Ethnicity | 3.5 | 4.2 | 1.3 | 3.8 | 4.5 | 3.8 | 2.2 | 2.6 |
| **Education (%)2** |  |  |  |  |  |  |  |  |
| Low | 46.2 | 49.7 | 53.1 | 52.9 | 47.9 | 49.8 | 52.1 | 53.0 |
| High | 53.8 | 50.3 | 46.9 | 47.1 | 52.1 | 50.2 | 47.9 | 47.0 |
| **Physical activity (%)** |  |  |  |  |  |  |  |  |
| No physical activity  | 34.2 | 36.8 | 39.4 | 44.7 | 36.9 | 38.2 | 40.2 | 39.9 |
| Physical activity | 65.8 | 63.2 | 60.6 | 55.3 | 63.1 | 61.8 | 59.8 | 60.1 |
| **Smoking (%)** |  |  |  |  |  |  |  |  |
| Never  | 56.3 | 60.8 | 54.7 | 57.6 | 56.3 | 61.1 | 56.9 | 55.6 |
| Former  | 11.4 | 16.2 | 17.0 | 18.8 | 13.6 | 14.4 | 16.9 | 17.9 |
| Current  | 32.3 | 23.1 | 28.3 | 23.6 | 30.1 | 24.4 | 26.1 | 26.5 |
| **Alcohol intake (g/d)**  | 7.0 (13.7) | 7.0 (13.2) | 8.4 (17.6) | 5.9 (11.1) | 7.3 (14.2) | 7.3 (12.9) | 7.5 (15.5) | 5.9 (12.9) |
| **Diabetes mellitus (%)** | 0.8 | 1.6 | 1.9 | 3.8 | 0.7 | 1.6 | 2.1 | 4.1 |

NHANES: U.S. National Health and Nutrition Examination Survey.

1 Age-standardization was obtained via direct standardization to the baseline age distribution of the analytic cohort. Sex-specific quartiles of fat mass index were defined by their distribution (25th quantile, median, 75th quantile); for men: 25th quantile=4.80 kg/m2, median=6.40 kg/m2, 75th quantile=8.20 kg/m2; for women: 25th quantile=8.50 kg/m2, median=10.70 kg/m2, 75th quantile=14.05 kg/m2.

Sex-specific quartiles of fat-free mass index were defined by their distribution (25th quantile, median, 75th quantile); for men: 25th quantile=18.05 kg/m2, median=20.00 kg/m2, 75th quantile=22.10 kg/m2; for women: 25th quantile=14.40 kg/m2, median=16.00 kg/m2, 75th quantile=18.40 kg/m2.

2 Low education is defined as ≤10 years of education for KORA and SHIP or “<9th Grade/9-11th Grade/High School Graduate/GED or Equivalent” for NHANES. High education is defined as >10 years of education for KORA and SHIP or “Some College or AA degree/College Graduate or above” for NHANES.

Supplementary Table 5: Age-standardized baseline characteristics of participants according to sex-specific quartiles of fat mass index and fat-free mass index in NHANES 2001/2002 (n=1,477)1.

|  |  |  |
| --- | --- | --- |
|  | **Fat mass index** | **Fat-free mass index** |
| Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
|  | Mean (SD) or % | Mean (SD) or % |
| No. (%) | 382 (25.9) | 372 (25.2) | 361 (24.4) | 362 (24.5) | 375 (25.4) | 375 (25.4) | 367 (24.8) | 360 (24.4) |
| Age (years)  | 32.5 (8.6) | 34.5 (9.0) | 35.6 (8.6) | 36.5 (8.7) | 33.2 (9.1) | 34.7 (8.8) | 35.2 (8.6) | 35.9 (8.7) |
| **Sex (%)** |  |  |  |  |  |  |  |  |
| Men | 51.6 | 54.5 | 50.5 | 52.9 | 51.5 | 54.2 | 51.5 | 53.5 |
| Women | 48.4 | 45.5 | 49.5 | 47.1 | 48.5 | 45.8 | 48.5 | 46.5 |
| **Anthropometric variables** |  |  |  |  |  |  |  |  |
| Fat mass index (kg/m2)  | 4.8 (1.7) | 7.2 (1.8) | 9.6 (2.4) | 13.6 (3.7) | 7.4 (2.6) | 8.0 (3.4) | 8.9 (3.8) | 10.7 (5.3) |
| Fat-free mass index (kg/m2) | 17.9 (3.6) | 17.8 (3.3) | 18.6 (3.2) | 20.2 (3.2) | 15.1 (1.9) | 17.5 (2.1) | 19.2 (2.0) | 22.7 (2.4) |
| Body mass index (kg/m2)  | 22.7 (2.8) | 25.0 (2.8) | 28.2 (3.0) | 33.8 (4.9) | 22.5 (2.8) | 25.5 (3.1) | 28.1 (3.3) | 33.5 (5.0) |
| Body fat mass (kg) | 13.3 (4.7) | 20.3 (4.1) | 26.8 (5.0) | 39.1 (9.5) | 21.4 (7.3) | 22.8 (9.4) | 24.8 (10.5) | 29.9 (14.7) |
| Body weight (kg) | 65.2 (12.7) | 71.7 (11.6) | 80.3 (12.7) | 97.8 (15.0) | 65.2 (11.9) | 73.7 (12.8) | 80.2 (13.7) | 95.6 (16.7) |
| **Ethnicity (%)** |  |  |  |  |  |  |  |  |
| Mexican American | 23.2 | 27.8 | 32.0 | 25.8 | 20.3 | 28.3 | 28.7 | 30.6 |
| Other Hispanic | 3.4 | 3.5 | 4.2 | 4.7 | 4.0 | 2.1 | 4.9 | 4.3 |
| Non-Hispanic White | 51.4 | 46.6 | 36.4 | 43.6 | 49.9 | 47.2 | 44.0 | 38.3 |
| Non-Hispanic Black | 16.5 | 18.5 | 23.6 | 24.3 | 20.0 | 19.5 | 19.2 | 24.6 |
| Other Ethnicity | 5.5 | 3.7 | 3.7 | 1.6 | 5.8 | 3.0 | 3.2 | 2.3 |
| **Education (%)2** |  |  |  |  |  |  |  |  |
| Low | 48.9 | 52.7 | 50.6 | 47.9 | 45.8 | 48.1 | 51.5 | 55.0 |
| High | 51.1 | 47.3 | 49.4 | 52.1 | 54.2 | 51.9 | 48.5 | 45.0 |
| **Physical activity (%)** |  |  |  |  |  |  |  |  |
| No physical activity  | 26.2 | 32.7 | 31.0 | 35.9 | 33.4 | 28.2 | 32.8 | 32.1 |
| Physical activity | 73.8 | 67.3 | 69.0 | 64.1 | 66.6 | 71.8 | 67.2 | 67.9 |
| **Smoking (%)** |  |  |  |  |  |  |  |  |
| Never  | 53.1 | 52.6 | 60.8 | 58.8 | 52.5 | 56.9 | 54.6 | 61.4 |
| Former  | 11.3 | 16.8 | 12.3 | 13.6 | 13.4 | 13.7 | 13.2 | 12.6 |
| Current  | 35.6 | 30.5 | 26.8 | 27.6 | 34.1 | 29.5 | 32.2 | 25.9 |
| **Alcohol intake (g/d)**  | 6.6 (10.9) | 7.5 (13.1) | 7.7 (16.6) | 6.5 (15.9) | 7.9 (14.3) | 7.0 (12.0) | 6.9 (15.8) | 7.1 (15.0) |
| **Diabetes mellitus (%)** | 1.9 | 1.9 | 3.2 | 5.8 | 1.5 | 2.2 | 5.3 | 3.9 |

NHANES: U.S. National Health and Nutrition Examination Survey.

1 Age-standardization was obtained via direct standardization to the baseline age distribution of the analytic cohort. Sex-specific quartiles of fat mass index were defined by their distribution (25th quantile, median, 75th quantile); for men: 25th quantile=4.60 kg/m2, median=6.50 kg/m2, 75th quantile=8.30 kg/m2; for women: 25th quantile=7.80 kg/m2, median=10.20 kg/m2, 75th quantile=13.60 kg/m2.

Sex-specific quartiles of fat-free mass index were defined by their distribution (25th quantile, median, 75th quantile); for men: 25th quantile=18.20 kg/m2, median=20.10 kg/m2, 75th quantile=22.30 kg/m2; for women: 25th quantile=14.40 kg/m2, median=16.10 kg/m2, 75th quantile=18.60 kg/m2.

2 Low education is defined as ≤10 years of education for KORA and SHIP or “<9th Grade/9-11th Grade/High School Graduate/GED or Equivalent” for NHANES. High education is defined as >10 years of education for KORA and SHIP or “Some College or AA degree/College Graduate or above” for NHANES.

Supplementary Table 6: Age-standardized baseline characteristics of participants according to sex-specific quartiles of fat mass index and fat-free mass index in NHANES 2003/2004 (n=1,327)1.

|  |  |  |
| --- | --- | --- |
|  | **Fat mass index** | **Fat-free mass index** |
| Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
|  | Mean (SD) or % | Mean (SD) or % |
| No. (%) | 339 (25.5) | 334 (25.2) | 327 (24.6) | 327 (24.6) | 335 (25.2) | 337 (25.4) | 326 (24.6) | 329 (24.8) |
| Age (years)  | 31.5 (8.4) | 33.7 (8.5) | 36.0 (9.1) | 34.9 (8.7) | 32.6 (8.8) | 34.0 (8.9) | 34.2 (8.8) | 35.2 (8.6) |
| **Sex (%)** |  |  |  |  |  |  |  |  |
| Men | 53.0 | 56.3 | 54.6 | 55.9 | 55.2 | 55.9 | 54.5 | 55.9 |
| Women | 47.0 | 43.7 | 45.4 | 44.1 | 44.8 | 44.1 | 45.5 | 44.1 |
| **Anthropometric variables** |  |  |  |  |  |  |  |  |
| Fat mass index (kg/m2)  | 4.8 (1.8) | 7.0 (1.9) | 9.4 (2.5) | 13.4 (4.1) | 6.8 (2.3) | 7.6 (3.1) | 9.0 (4.2) | 11.0 (5.3) |
| Fat-free mass index (kg/m2) | 17.4 (3.4) | 18.2 (3.6) | 19.2 (3.2) | 20.9 (3.0) | 15.1 (1.9) | 17.7 (2.1) | 19.8 (2.1) | 23.2 (2.3) |
| Body mass index (kg/m2)  | 22.2 (2.7) | 25.2 (3.1) | 28.6 (3.2) | 34.4 (5.0) | 21.9 (2.4) | 25.3 (2.8) | 28.8 (3.7) | 34.2 (4.9) |
| Body fat mass (kg) | 13.3 (4.7) | 20.0 (4.2) | 26.5 (5.6) | 38.9 (11.1) | 19.8 (6.5) | 21.5 (8.6) | 25.6 (11.8) | 31.1 (14.8) |
| Body weight (kg) | 64.0 (11.4) | 73.0 (12.7) | 82.0 (11.9) | 99.8 (15.3) | 64.3 (11.1) | 72.9 (11.6) | 83.5 (14.2) | 98.0 (16.3) |
| **Ethnicity (%)** |  |  |  |  |  |  |  |  |
| Mexican American | 15.0 | 21.3 | 26.8 | 23.9 | 16.1 | 26.4 | 19.2 | 23.0 |
| Other Hispanic | 2.5 | 5.8 | 4.5 | 2.3 | 4.2 | 2.4 | 3.6 | 5.6 |
| Non-Hispanic White | 55.1 | 53.0 | 43.8 | 38.8 | 54.4 | 49.2 | 48.8 | 38.6 |
| Non-Hispanic Black | 19.9 | 14.9 | 21.1 | 31.4 | 18.1 | 16.6 | 25.0 | 28.5 |
| Other Ethnicity | 7.6 | 5.0 | 3.8 | 3.6 | 7.2 | 5.4 | 3.4 | 4.3 |
| **Education (%)2** |  |  |  |  |  |  |  |  |
| Low | 39.2 | 39.2 | 58.2 | 49.0 | 40.4 | 47.0 | 44.3 | 52.9 |
| High | 60.8 | 60.8 | 41.8 | 51.0 | 59.6 | 53.0 | 55.7 | 47.1 |
| **Physical activity (%)** |  |  |  |  |  |  |  |  |
| No physical activity  | 23.7 | 25.6 | 37.8 | 35.5 | 31.7 | 33.1 | 25.3 | 31.8 |
| Physical activity | 76.3 | 74.4 | 62.2 | 64.5 | 68.3 | 66.9 | 74.7 | 68.2 |
| **Smoking (%)** |  |  |  |  |  |  |  |  |
| Never  | 53.5 | 55.0 | 54.7 | 56.4 | 48.9 | 57.9 | 58.0 | 55.0 |
| Former  | 13.1 | 17.0 | 12.8 | 11.6 | 12.8 | 13.3 | 13.9 | 13.9 |
| Current  | 33.4 | 28.0 | 32.6 | 32.0 | 38.3 | 28.8 | 28.1 | 31.1 |
| **Alcohol intake (g/d)**  | 8.9 (18.1) | 6.3 (13.3) | 8.8 (16.2) | 6.5 (12.0) | 8.0 (13.7) | 7.8 (16.1) | 6.9 (11.3) | 7.5 (16.5) |
| **Diabetes mellitus (%)** | 0.7 | 1.2 | 3.3 | 6.4 | 2.3 | 1.2 | 3.0 | 5.4 |

NHANES: U.S. National Health and Nutrition Examination Survey.

1 Age-standardization was obtained via direct standardization to the baseline age distribution of the analytic cohort. Sex-specific quartiles of fat mass index were defined by their distribution (25th quantile, median, 75th quantile); for men: 25th quantile=4.40 kg/m2, median=6.40 kg/m2, 75th quantile=8.10 kg/m2; for women: 25th quantile=7.80 kg/m2, median=10.40 kg/m2, 75th quantile=14.00 kg/m2.

Sex-specific quartiles of fat-free mass index were defined by their distribution (25th quantile, median, 75th quantile); for men: 25th quantile=18.20 kg/m2, median=20.60 kg/m2, 75th quantile=22.60 kg/m2; for women: 25th quantile=14.40 kg/m2, median=16.40 kg/m2, 75th quantile=18.90 kg/m2.

2 Low education is defined as ≤10 years of education for KORA and SHIP or “<9th Grade/9-11th Grade/High School Graduate/GED or Equivalent” for NHANES. High education is defined as >10 years of education for KORA and SHIP or “Some College or AA degree/College Graduate or above” for NHANES.

Supplementary Table 7: Age-standardized baseline characteristics of participants according to sex-specific quartiles of fat mass index and fat-free mass index in SHIP-2 2008/2012 (n=1,522)1.

|  |  |  |
| --- | --- | --- |
|  | **Fat mass index** | **Fat-free mass index** |
| Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
|  | Mean (SD) or % | Mean (SD) or % |
| No. (%) | 387 (25.4) | 387 (25.4) | 383 (25.2) | 365 (24.0) | 392 (25.8) | 382 (25.1) | 375 (24.6) | 373 (24.5) |
| Age (years)  | 51.5 (13.4) | 55.1 (13.2) | 57.1 (12.4) | 57.0 (11.9) | 51.2 (13.1) | 54.9 (12.8) | 56.5 (12.5) | 58.1 (12.4) |
| **Sex (%)** |  |  |  |  |  |  |  |  |
| Men | 47.6 | 47.7 | 45.7 | 44.7 | 49.9 | 45.3 | 46.0 | 45.1 |
| Women | 52.4 | 52.3 | 54.3 | 55.3 | 50.1 | 54.7 | 54.0 | 54.9 |
| **Anthropometric variables** |  |  |  |  |  |  |  |  |
| Fat mass index (kg/m2)  | 5.1 (1.1) | 7.0 (1.0) | 9.0 (1.5) | 12.7 (3.1) | 6.3 (1.7) | 7.4 (2.1) | 8.7 (2.6) | 11.5 (4.0) |
| Fat-free mass index (kg/m2) | 18.2 (2.5) | 18.8 (2.5) | 19.8 (2.4) | 21.5 (2.4) | 17.2 (1.8) | 18.8 (1.9) | 20.1 (2.0) | 22.3 (2.3) |
| Body mass index (kg/m2)  | 23.3 (2.3) | 25.9 (2.0) | 28.9 (2.0) | 34.2 (3.5) | 23.5 (2.2) | 26.1 (2.4) | 28.8 (2.5) | 33.9 (3.9) |
| Body fat mass (kg) | 14.4 (2.9) | 20.1 (2.1) | 25.6 (3.4) | 35.9 (7.6) | 18.3 (5.0) | 21.0 (6.0) | 24.7 (7.3) | 32.1 (10.5) |
| Body weight (kg) | 67.2 (11.3) | 74.5 (10.9) | 82.8 (11.0) | 98.0 (13.7) | 69.1 (10.7) | 75.1 (11.9) | 82.6 (13.1) | 96.1 (15.3) |
| **Ethnicity (%)** |  |  |  |  |  |  |  |  |
| Non-Hispanic White | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| **Education (%)2** |  |  |  |  |  |  |  |  |
| Low | 19.7 | 20.7 | 17.6 | 25.2 | 18.0 | 17.9 | 22.5 | 23.3 |
| High | 80.3 | 79.3 | 82.4 | 74.8 | 82.0 | 82.1 | 77.5 | 76.7 |
| **Physical activity (%)** |  |  |  |  |  |  |  |  |
| No physical activity  | 28.9 | 28.6 | 30.2 | 39.0 | 31.4 | 28.2 | 30.7 | 35.8 |
| Physical activity | 71.1 | 71.4 | 69.8 | 61.0 | 68.6 | 71.8 | 69.3 | 64.2 |
| **Smoking (%)** |  |  |  |  |  |  |  |  |
| Never  | 40.3 | 34.6 | 39.0 | 37.4 | 34.7 | 41.5 | 38.9 | 35.9 |
| Former  | 34.3 | 38.9 | 38.7 | 43.4 | 41.2 | 34.8 | 36.0 | 44.4 |
| Current  | 25.4 | 26.5 | 22.3 | 19.2 | 24.1 | 23.7 | 25.1 | 19.7 |
| **Alcohol intake (g/d)**  | 9.4 (13.1) | 9.8 (13.8) | 9.1 (12.2) | 9.0 (15.1) | 10.1 (15.0) | 9.0 (12.8) | 9.3 (13.5) | 8.9 (13.5) |
| **Diabetes mellitus (%)** | 7.8 | 9.5 | 11.5 | 19.4 | 5.8 | 8.9 | 12.8 | 20.5 |

SHIP: Study of Health in Pomerania.

1 Age-standardization was obtained via direct standardization to the baseline age distribution of the analytic cohort. Sex-specific quartiles of fat mass index were defined by their distribution (25th quantile, median, 75th quantile); for men: 25th quantile=5.40 kg/m2, median=6.80 kg/m2, 75th quantile=8.40 kg/m2; for women: 25th quantile=6.90 kg/m2, median=8.80 kg/m2, 75th quantile=11.80 kg/m2.

Sex-specific quartiles of fat-free mass index were defined by their distribution (25th quantile, median, 75th quantile); for men: 25th quantile=20.00 kg/m2, median=21.50 kg/m2, 75th quantile=23.00 kg/m2; for women: 25th quantile=16.40 kg/m2, median=17.60 kg/m2, 75th quantile=19.10 kg/m2.

2 Low education is defined as ≤10 years of education for KORA and SHIP or “<9th Grade/9-11th Grade/High School Graduate/GED or Equivalent” for NHANES. High education is defined as >10 years of education for KORA and SHIP or “Some College or AA degree/College Graduate or above” for NHANES.

Supplementary Table 8: Age-standardized baseline characteristics of participants according to sex-specific quartiles of fat mass index and fat-free mass index in SHIP-Trend 2008/2012 (n=3,416)1.

|  |  |  |
| --- | --- | --- |
|  | **Fat mass index** | **Fat-free mass index** |
| Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
|  | Mean (SD) or % | Mean (SD) or % |
| No. (%) | 878 (25.7) | 851 (24.9) | 843 (24.7) | 844 (24.7) | 879 (25.7) | 839 (24.6) | 870 (25.5) | 828 (24.2) |
| Age (years)  | 42.4 (14.0) | 48.5 (14.2) | 52.1 (14.3) | 53.6 (13.4) | 43.1 (14.4) | 47.8 (14.6) | 51.3 (14.2) | 54.4 (12.7) |
| **Sex (%)** |  |  |  |  |  |  |  |  |
| Men | 48.6 | 47.0 | 48.0 | 48.2 | 48.5 | 46.7 | 46.6 | 49.3 |
| Women | 51.4 | 53.0 | 52.0 | 51.8 | 51.5 | 53.3 | 53.4 | 50.7 |
| **Anthropometric variables** |  |  |  |  |  |  |  |  |
| Fat mass index (kg/m2)  | 4.8 (1.1) | 6.9 (1.1) | 8.9 (1.6) | 12.6 (3.2) | 6.1 (1.8) | 7.3 (2.2) | 8.6 (2.7) | 11.4 (4.1) |
| Fat-free mass index (kg/m2) | 18.0 (2.5) | 18.7 (2.4) | 19.7 (2.5) | 21.5 (2.5) | 16.9 (1.7) | 18.6 (1.9) | 19.9 (2.0) | 22.4 (2.3) |
| Body mass index (kg/m2)  | 22.8 (2.3) | 25.6 (1.9) | 28.5 (2.0) | 34.0 (3.7) | 23.0 (2.3) | 25.9 (2.3) | 28.5 (2.5) | 33.8 (4.0) |
| Body fat mass (kg) | 13.9 (2.9) | 20.0 (2.6) | 25.7 (3.6) | 36.3 (8.6) | 17.7 (5.5) | 21.2 (6.4) | 24.5 (7.6) | 32.4 (11.4) |
| Body weight (kg) | 66.7 (11.0) | 74.8 (10.8) | 83.5 (10.9) | 99.3 (14.2) | 67.9 (10.9) | 76.0 (12.4) | 82.7 (12.4) | 97.6 (15.9) |
| **Ethnicity (%)** |  |  |  |  |  |  |  |  |
| Non-Hispanic White | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| **Education (%)2** |  |  |  |  |  |  |  |  |
| Low | 13.8 | 11.4 | 17.4 | 20.8 | 14.1 | 13.4 | 15.1 | 22.0 |
| High | 86.2 | 88.6 | 82.6 | 79.2 | 85.9 | 86.6 | 84.9 | 78.0 |
| **Physical activity (%)** |  |  |  |  |  |  |  |  |
| No physical activity  | 27.7 | 27.2 | 31.3 | 40.1 | 31.8 | 27.2 | 30.6 | 37.0 |
| Physical activity | 72.3 | 72.8 | 68.7 | 59.9 | 68.2 | 72.8 | 69.4 | 63.0 |
| **Smoking (%)** |  |  |  |  |  |  |  |  |
| Never  | 37.0 | 36.6 | 36.8 | 34.8 | 35.9 | 37.3 | 35.5 | 34.3 |
| Former  | 29.8 | 34.2 | 34.6 | 37.1 | 31.1 | 33.3 | 35.3 | 36.5 |
| Current  | 33.2 | 29.2 | 28.6 | 28.1 | 33.1 | 29.5 | 29.2 | 29.2 |
| **Alcohol intake (g/d)**  | 0.3 (0.4) | 0.3 (0.5) | 0.3 (0.5) | 0.3 (0.4) | 0.3 (0.4) | 0.3 (0.5) | 0.3 (0.4) | 0.3 (0.5) |
| **Diabetes mellitus (%)** | 4.7 | 5.1 | 8.6 | 15.9 | 3.5 | 6.1 | 8.0 | 16.1 |

SHIP: Study of Health in Pomerania.

1 Age-standardization was obtained via direct standardization to the baseline age distribution of the analytic cohort. Sex-specific quartiles of fat mass index were defined by their distribution (25th quantile, median, 75th quantile); for men: 25th quantile=5.10 kg/m2, median=6.50 kg/m2, 75th quantile=8.20 kg/m2; for women: 25th quantile=6.70 kg/m2, median=8.90 kg/m2, 75th quantile=11.70 kg/m2.

Sex-specific quartiles of fat-free mass index were defined by their distribution (25th quantile, median, 75th quantile); for men: 25th quantile=19.70 kg/m2, median=21.20 kg/m2, 75th quantile=22.80 kg/m2; for women: 25th quantile=16.20 kg/m2, median=17.40 kg/m2, 75th quantile=18.90 kg/m2.

2 Low education is defined as ≤10 years of education for KORA and SHIP or “<9th Grade/9-11th Grade/High School Graduate/GED or Equivalent” for NHANES. High education is defined as >10 years of education for KORA and SHIP or “Some College or AA degree/College Graduate or above” for NHANES.

Supplementary Table 9: Indicators of body mass index and fat mass index for prediction of total mortality.

|  |  |  |
| --- | --- | --- |
|  | **Model 1**1 | **Model 2**2 |
| AIC | 19313.64 | 19306.11 |
| Harrell’s Concordance-index  | 0.414 | 0.439 |
| Likelihood ratio test | 0.002 |

AIC: Akaike’s Information Criterion.

1Model 1 included the predictors body mass index, sex, ethnicity, study, history of diabetes mellitus at baseline, education, smoking, physical activity, and alcohol consumption.

2Model 2 was additionally adjusted for fat mass index.

**Supplementary Table 10: Relations of fat mass index and fat-free mass index to total mortality in the complete case dataset (n=16,155) and after chained-equation multiple imputation (n=24,471)1.**

|  |  |  |
| --- | --- | --- |
|  | **Total mortality** | **Total mortality** |
| Complete case dataset | Sensitivity analysis: Multiple imputation |
| **Fat mass index [kg/m2]** | HR (95% CI) | n | HR (95% CI) | n |
| 5.2 | 1.08 (0.96, 1.20) | 162 | 0.97 (0.87, 1.07) | 181 |
| 7.32 | 1 | 266 | 1 | 292 |
| 9.2 | 1.18 (1.07, 1.29) | 378 | 1.30 (1.19, 1.42) | 414 |
| 13.0 | 1.56 (1.30, 1.87) | 541 | 1.93 (1.62, 2.28) | 569 |
| *Overall P value* | <0.001 |  | <0.001 |  |
| **Fat-free mass index [kg/m2]**  |  |  |  |  |
| 16.12 |  1 | 338 | 1 | 358 |
| 17.8 | 0.83 (0.76, 0.91) | 384 | 0.76 (0.70, 0.82) | 404 |
| 19.2 | 0.73 (0.63, 0.85) | 356 | 0.62 (0.54, 0.71) | 388 |
| 21.9 | 0.70 (0.56, 0.87) | 269 | 0.51 (0.42, 0.63) | 306 |
| *Overall P value* | <0.001 |  | <0.001 |  |

FU: follow-up time; HR: hazard ratio; CI: confidence interval; n: number of total mortality cases in each sex-specific quartile.

1 Hazard ratios from Cox proportional hazards regression using age as the underlying time metric. Adjusted for sex; ethnicity; study; history of diabetes mellitus at baseline; education; smoking; physical activity; and alcohol intake. Fat mass index and fat-free mass index were mutually adjusted.

2 Reference groups for fat mass index=7.3 kg/m2 and for fat-free mass index=16.1 kg/m2 were set according to predicted cubic spline functions. Fat mass index and fat-free mass index measurement points were selected using means of sex-specific quartiles.



**Supplementary Figure 4:** Spline functions with corresponding 95% CI from Cox proportional hazards regression for the relations of fat mass index (kg/m2)and fat-free mass index (kg/m2)to total mortality in the multiple-imputed dataset (n=24,471).