# Supplementary Table 1: Descriptions of different exposures.

|  |  |  |  |
| --- | --- | --- | --- |
| Parameters | **Definitions** | **Calculation** | **Implications** |
| **Muscle mass indices (kg/m2)** |  |  | The absolute muscle mass is affected by height. Muscle mass indices are relative measures of muscle mass controlling for the influence of height. |
| Appendicular muscle mass index | The amount of appendicular muscle divided by height squared | (Arm muscle mass + leg muscle mass) / (Height)2 |
| Total muscle mass index | The total amount of muscle in human bodies divided by height squared | (Arm muscle mass + leg muscle mass + trunk muscle mass) / (Height)2 |
| Arm muscle mass index | The amount of muscle arms divided by height squared | Arm muscle mass / (Height)2 |
| Leg muscle mass index | The amount of muscle in legs divided by height squared | Leg muscle mass / (Height)2 |
| Trunk muscle mass index | The amount of muscle in the trunk divided by height squared | Trunk muscle mass / (Height)2 |
| **Grip strength (kg)** | Strength of the upper limb | Measured by hydraulic hand dynamometer (Jamar J00105) | An important index for muscle strength in the upper limb |
| **Arm muscle quality (kg/kg)** | Grip strength for per unit of muscle mass in the upper limb | Grip strength / arm muscle mass | Muscle strength decays faster than muscle mass with aging. Arm muscle quality reflects the muscle strength adjusted for mucle mass in the upper limb. |

|  |  |
| --- | --- |
|  |  |

# Supplementary Figure 1: Restricted cubic splines for associations of grip strength and arm muscle quality with all-cause mortality. The four knots for restricted cubic splines were set at the 5th, 35th, 65th, and 95th percentages of grip strength (or arm muscle quality) and the lowest values of corresponding indices were the reference points. Solid lines represent hazard ratios and dashed lines represent 95% confidence intervals. Likelihood ratio tests were used to test for non-linearity (grip strength: *P*=0.815; arm muscle quality: *P*=0.156). Models were adjusted for variables in model 3 of Table 2.

# Supplementary Table 2: Sensitivity analyses for associations of muscle mass indices, grip strength, and arm muscle quality with all-cause mortality

| **Muscle mass indices** | **Binary Category** | |  | **Quintiles** | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Normal** | **Low** |  | **Q1** | **Q2** | **Q3** | **Q4** | **Q5** |
| **Appendicular muscle mass index** | | | | | | | | |
| Model 3a | 1.00 | 1.20 (1.03-1.41) |  | 1.19 (0.96-1.48) | 0.94 (0.74-1.18) | 1.00 | 1.00 (0.78-1.27) | 1.06 (0.83-1.36) |
| Model 3b | 1.00 | 1.24 (1.03-1.49) |  | 1.26 (0.98-1.63) | 0.96 (0.73-1.27) | 1.00 | 1.09 (0.82-1.44) | 1.10 (0.82-1.47) |
| Model 3c | 1.00 | 1.26 (1.04-1.52) |  | 1.29 (0.99-1.68) | 1.00 (0.75-1.34) | 1.00 | 1.03 (0.76-1.40) | 1.13 (0.82-1.54) |
| Model 3d | 1.00 | 1.22 (0.97-1.54) |  | 1.23 (0.91-1.68) | 1.06 (0.76-1.47) | 1.00 | 0.87 (0.61-1.24) | 1.11 (0.79-1.56) |
| **Total muscle mass index** | | | | | | | | |
| Model 3a | 1.00 | 1.31 (1.11-1.53) |  | 1.32 (1.07-1.63) | 0.98 (0.78-1.24) | 1.00 | 1.05 (0.83-1.33) | 1.05 (0.82-1.34) |
| Model 3b | 1.00 | 1.24 (1.03-1.49) |  | 1.18 (0.93-1.50) | 0.90 (0.69-1.18) | 1.00 | 0.94 (0.72-1.24) | 0.99 (0.74-1.31) |
| Model 3c | 1.00 | 1.38 (1.14-1.67) |  | 1.34 (1.04-1.72) | 0.97 (0.73-1.28) | 1.00 | 0.90 (0.66-1.21) | 1.02 (0.75-1.38) |
| Model 3d | 1.00 | 1.25 (0.99-1.58) |  | 1.32 (0.97-1.80) | 1.07 (0.77-1.50) | 1.00 | 1.18 (0.84-1.65) | 0.92 (0.64-1.33) |
| **Arm muscle mass index** | | | | | | | | |
| Model 3a | 1.00 | 1.44 (1.23-1.68) |  | 1.28 (1.04-1.58) | 0.84 (0.66-1.06) | 1.00 | 0.94 (0.73-1.20) | 0.79 (0.61-1.02) |
| Model 3b | 1.00 | 1.42 (1.18-1.71) |  | 1.26 (0.98-1.60) | 0.82 (0.62-1.07) | 1.00 | 0.97 (0.73-1.28) | 0.75 (0.55-1.01) |
| Model 3c | 1.00 | 1.61 (1.33-1.94) |  | 1.34 (1.04-1.72) | 0.75 (0.56-1.01) | 1.00 | 0.81 (0.59-1.10) | 0.76 (0.55-1.04) |
| Model 3d | 1.00 | 1.43 (1.13-1.80) |  | 1.34 (0.99-1.83) | 0.96 (0.69-1.35) | 1.00 | 0.99 (0.70-1.40) | 0.77 (0.53-1.11) |
| **Leg muscle mass index** | | | | | | | | |
| Model 3a | 1.00 | 1.11 (0.94-1.30) |  | 1.11 (0.89-1.37) | 0.95 (0.75-1.20) | 1.00 | 0.96 (0.75-1.23) | 1.15 (0.91-1.46) |
| Model 3b | 1.00 | 1.11 (0.92-1.34) |  | 1.12 (0.87-1.45) | 0.97 (0.73-1.27) | 1.00 | 0.97 (0.73-1.30) | 1.17 (0.88-1.55) |
| Model 3c | 1.00 | 1.14 (0.93-1.38) |  | 1.19 (0.91-1.56) | 1.04 (0.78-1.40) | 1.00 | 0.97 (0.71-1.33) | 1.23 (0.90-1.68) |
| Model 3d | 1.00 | 1.12 (0.89-1.42) |  | 1.19 (0.86-1.64) | 1.14 (0.81-1.59) | 1.00 | 0.91 (0.63-1.30) | 1.19 (0.85-1.67) |
| **Trunk muscle mass index** | | | | | | | | |
| Model 3a | 1.00 | 1.48 (1.25-1.75) |  | 1.43 (1.15-1.78) | 0.95 (0.75-1.20) | 1.00 | 0.96 (0.76-1.21) | 0.97 (0.77-1.22) |
| Model 3b | 1.00 | 1.41 (1.15-1.72) |  | 1.27 (0.99-1.64) | 0.79 (0.60-1.05) | 1.00 | 0.96 (0.74-1.24) | 0.89 (0.68-1.17) |
| Model 3c | 1.00 | 1.54 (1.26-1.90) |  | 1.53 (1.17-2.01) | 0.99 (0.73-1.33) | 1.00 | 1.04 (0.78-1.38) | 0.93 (0.69-1.25) |
| Model 3d | 1.00 | 1.71 (1.33-2.19) |  | 1.43 (1.04-1.97) | 0.61 (0.42-0.90) | 1.00 | 1.05 (0.76-1.45) | 0.77 (0.54-1.09) |
| **Grip strength** | | | | | | | | |
| Model 3a | 1.00 | 1.65 (1.40-1.94) |  | 2.26 (1.60-3.20) | 1.62 (1.15-2.28) | 1.17 (0.82-1.67) | 1.13 (0.78-1.62) | 1.00 |
| Model 3b | 1.00 | 1.57 (1.30-1.89) |  | 1.95 (1.33-2.88) | 1.48 (1.00-2.18) | 1.07 (0.71-1.60) | 0.98 (0.65-1.50) | 1.00 |
| Model 3c | 1.00 | 1.74 (1.42-2.13) |  | 1.97 (1.30-3.00) | 1.38 (0.90-2.10) | 0.88 (0.56-1.38) | 0.87 (0.55-1.39) | 1.00 |
| Model 3d | 1.00 | 1.59 (1.26-2.02) |  | 1.74 (1.09-2.79) | 1.30 (0.80-2.09) | 0.82 (0.49-1.37) | 1.00 (0.60-1.68) | 1.00 |
| **Arm muscle quality** | | | | | | | | |
| Model 3a | 1.00 | 1.38 (1.18-1.60) |  | 1.48 (1.19-1.84) | 1.26 (1.00-1.59) | 1.00 | 0.84 (0.64-1.11) | 1.02 (0.76-1.35) |
| Model 3b | 1.00 | 1.33 (1.11-1.59) |  | 1.41 (1.10-1.82) | 1.19 (0.91-1.55) | 1.00 | 0.89 (0.65-1.22) | 1.05 (0.76-1.45) |
| Model 3c | 1.00 | 1.41 (1.17-1.70) |  | 1.58 (1.20-2.08) | 1.30 (0.97-1.73) | 1.00 | 0.88 (0.62-1.25) | 1.20 (0.85-1.71) |
| Model 3d | 1.00 | 1.26 (1.00-1.58) |  | 1.33 (0.97-1.84) | 1.18 (0.84-1.65) | 1.00 | 0.87 (0.57-1.31) | 1.05 (0.68-1.62) |

All the analyses were conducted based on model 3 of Table 2.

Model 3a: including participants with self-reported diagnosis of cardiovascular diseases or cancer and was additionally adjusted for self-reported diagnosis of cardiovascular diseases or cancer.

Model 3b: excluding participants who died within the first year of follow-up.

Model 3c: excluding participants whose body weight changed more than 2.5 kg during the past 1 year.

Model 3d: Excluding participants who ever smoked.

# Supplementary Table 3: Associations of muscle mass indices, grip strength, and arm muscle quality with all-cause mortality by sex

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | **Male** | |  | **Female** | | ***P*int** |
| **Normal** | **Low** |  | **Reference**  **group** | **Low** |
| **Muscle mass indices** | | | | | | |
| **Appendicular muscle mass index** | | | | | | |
| Person-years | 27,251 | 6,555 |  | 44,787 | 11,163 |  |
| No. of death | 222 | 176 |  | 243 | 98 |  |
| Crude mortality\* | 8.2 | 26.9 |  | 5.4 | 8.8 |  |
| HR (95% CI) | 1.00 | 1.34 (1.06-1.69) |  | 1.00 | 1.17 (0.91-1.50) | 0.243 |
| **Total muscle mass index** | | | | | | |
| Person-years | 27,252 | 6,553 |  | 44,722 | 11,228 |  |
| No. of death | 235 | 163 |  | 245 | 96 |  |
| Crude mortality\* | 8.6 | 24.9 |  | 5.5 | 8.6 |  |
| HR (95% CI) | 1.00 | 1.51 (1.20-1.89) |  | 1.00 | 1.17 (0.90-1.52) | 0.068 |
| **Arm muscle mass index** | | | | | | |
| Person-years | 27,265 | 6,540 |  | 44,446 | 11,504 |  |
| No. of death | 210 | 188 |  | 238 | 103 |  |
| Crude mortality\* | 7.7 | 28.8 |  | 5.4 | 9.0 |  |
| HR (95% CI) | 1.00 | 1.59 (1.26-2.00) |  | 1.00 | 1.43 (1.11-1.86) | 0.377 |
| **Leg muscle mass index** | | | | | | |
| Person-years | 27,209 | 6,597 |  | 44,612 | 11,338 |  |
| No. of death | 232 | 166 |  | 243 | 98 |  |
| Crude mortality\* | 8.5 | 25.2 |  | 5.5 | 8.6 |  |
| HR (95% CI) | 1.00 | 1.16 (0.92-1.47) |  | 1.00 | 1.07 (0.83-1.38) | 0.369 |
| **Trunk muscle mass index** | | | | | | |
| Person-years | 27,208 | 6,597 |  | 44,763 | 11,187 |  |
| No. of death | 264 | 134 |  | 229 | 112 |  |
| Crude mortality\* | 9.7 | 20.3 |  | 5.1 | 10.0 |  |
| HR (95% CI) | 1.00 | 1.51 (1.18-1.92) |  | 1.00 | 1.61 (1.23-2.12) | 0.832 |
| **Grip strength** | | | | | | |
| Person-years | 27,361 | 6,445 |  | 44,902 | 11,048 |  |
| No. of death | 176 | 222 |  | 175 | 166 |  |
| Crude mortality\* | 6.43 | 34.5 |  | 3.9 | 15.0 |  |
| HR (95% CI) | 1.00 | 1.93 (1.52-2.46) |  | 1.00 | 1.47 (1.13-1.90) | 0.117 |
| **Arm muscle quality** | | | | | | |
| Person-years | 27,171 | 6,634 |  | 44,823 | 11,127 |  |
| No. of death | 230 | 168 |  | 194 | 147 |  |
| Crude mortality\* | 8.5 | 25.3 |  | 4.3 | 13.2 |  |
| HR (95% CI) | 1.00 | 1.72 (1.38-2.14) |  | 1.00 | 1.18 (0.92-1.52) | 0.061 |

HR=hazard ratio; CI=confidence interval.

Models were adjusted for the same variables as model 3 of Table 2, except for sex.

\* Per 1000 person-years.

**Supplementary Table 4: Associations of muscle mass indices, grip strength, and arm muscle quality with all-cause mortality by age.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameters | **Age <60 years** | |  | **Age ≥60 years** | | ***P*int** |
| **Normal** | **Low** |  | **Normal** | **Low** |
| **Muscle mass indices** | | | | | | |
| **Appendicular muscle mass index** | | | | | | |
| Person-years | 42,717 | 7,063 |  | 29,321 | 10,655 |  |
| No. of death | 93 | 27 |  | 372 | 247 |  |
| Crude mortality\* | 2.2 | 3.8 |  | 12.7 | 23.2 |  |
| HR (95% CI) | 1.00 | 1.77 (1.13-2.78) |  | 1.00 | 1.23 (1.03-1.48) | 0.150 |
| **Total muscle mass index** | | | | | | |
| Person-years | 42,246 | 7,533 |  | 29,728 | 10,247 |  |
| No. of death | 93 | 27 |  | 387 | 232 |  |
| Crude mortality\* | 2.2 | 3.6 |  | 13.0 | 22.6 |  |
| HR (95% CI) | 1.00 | 1.68 (1.07-2.65) |  | 1.00 | 1.35 (1.13-1.61) | 0.360 |
| **Arm muscle mass index** | | | | | | |
| Person-years | 42,366 | 7,414 |  | 29,346 | 10,630 |  |
| No. of death | 91 | 29 |  | 357 | 262 |  |
| Crude mortality\* | 2.2 | 3.9 |  | 12.2 | 24.7 |  |
| HR (95% CI) | 1.00 | 2.05 (1.30-3.22) |  | 1.00 | 1.49 (1.25-1.79) | 0.254 |
| **Leg muscle mass index** | | | | | | |
| Person-years | 42,615 | 7,165 |  | 29,207 | 10,769 |  |
| No. of death | 95 | 25 |  | 380 | 239 |  |
| Crude mortality\* | 2.2 | 3.5 |  | 13.0 | 22.2 |  |
| HR (95% CI) | 1.00 | 1.49 (0.94-2.35) |  | 1.00 | 1.12 (0.93-1.34) | 0.244 |
| **Trunk muscle mass index** | | | | | | |
| Person-years | 42,296 | 7,483 |  | 29,675 | 10,301 |  |
| No. of death | 94 | 26 |  | 399 | 220 |  |
| Crude mortality\* | 2.2 | 3.5 |  | 13.5 | 21.4 |  |
| HR (95% CI) | 1.00 | 1.66 (1.03-2.65) |  | 1.00 | 1.57 (1.29-1.90) | 0.731 |
| **Grip strength** |  |  |  |  |  |  |
| Person-years | 45,868 | 3,912 |  | 26,395 | 13,581 |  |
| No. of death | 94 | 26 |  | 257 | 362 |  |
| Crude mortality\* | 2.1 | 6.7 |  | 9.7 | 26.7 |  |
| HR (95% CI) | 1.00 | 2.47 (1.54-3.96) |  | 1.00 | 1.58 (1.32-1.90) | 0.089 |
| **Arm muscle quality** |  |  |  |  |  |  |
| Person-years | 44,171 | 5,609 |  | 27,824 | 12,152 |  |
| No. of death | 98 | 22 |  | 326 | 293 |  |
| Crude mortality\* | 2.2 | 3.9 |  | 11.7 | 24.1 |  |
| HR (95% CI) | 1.00 | 1.30 (0.79-2.12) |  | 1.00 | 1.42 (1.19-1.69) | 0.853 |

HR=hazard ratio; CI=confidence interval.

Models were adjusted for the same variables as model 3 of Table 2.

\* Per 1000 person-years.

**Supplementary Table 5: Associations of muscle mass indices, grip strength, and arm muscle quality with all-cause mortality by residential areas**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameters | **Urban areas** | |  | **Rural areas** | | ***P*int** |
| **Normal** | **Low** |  | **Normal** | **Low** |
| **Muscle mass indices** |  |  |  |  |  |  |
| **Appendicular muscle mass index** |  |  |  |  |  |  |
| Person-years | 30,788 | 7,593 |  | 41,250 | 10,124 |  |
| No. of death | 189 | 89 |  | 276 | 185 |  |
| Crude mortality \* | 6.1 | 11.7 |  | 6.7 | 18.3 |  |
| HR (95% CI) | 1.00 | 1.40 (1.06-1.85) |  | 1.00 | 1.21 (0.98-1.50) | 0.756 |
| **Total muscle mass index** |  |  |  |  |  |  |
| Person-years | 29,622 | 8,759 |  | 42,352 | 9,022 |  |
| No. of death | 182 | 96 |  | 298 | 163 |  |
| Crude mortality \* | 6.1 | 11.0 |  | 7.0 | 18.1 |  |
| HR (95% CI) | 1.00 | 1.47 (1.11-1.94) |  | 1.00 | 1.33 (1.08-1.64) | 0.956 |
| **Arm muscle mass index** |  |  |  |  |  |  |
| Person-years | 29,341 | 9,041 |  | 42,371 | 9,003 |  |
| No. of death | 168 | 110 |  | 280 | 181 |  |
| Crude mortality \* | 5.7 | 12.2 |  | 6.6 | 20.1 |  |
| HR (95% CI) | 1.00 | 1.71 (1.29-2.27) |  | 1.00 | 1.46 (1.19-1.80) | 0.871 |
| **Leg muscle mass index** |  |  |  |  |  |  |
| Person-years | 31,051 | 7,331 |  | 40,770 | 10,604 |  |
| No. of death | 198 | 80 |  | 277 | 184 |  |
| Crude mortality \* | 6.4 | 10.9 |  | 6.8 | 17.4 |  |
| HR (95% CI) | 1.00 | 1.25 (0.94-1.66) |  | 1.00 | 1.09 (0.88-1.35) | 0.867 |
| **Trunk muscle mass index** |  |  |  |  |  |  |
| Person-years | 29,191 | 9,191 |  | 42,781 | 8,594 |  |
| No. of death | 177 | 101 |  | 316 | 145 |  |
| Crude mortality\* | 6.1 | 11.0 |  | 7.4 | 16.9 |  |
| HR (95% CI) | 1.00 | 1.87 (1.37-2.55) |  | 1.00 | 1.47 (1.18-1.84) | 0.680 |
| **Grip strength** |  |  |  |  |  |  |
| Person-years | 30,924 | 7,458 |  | 41,339 | 10,035 |  |
| No. of death | 144 | 134 |  | 207 | 254 |  |
| Crude mortality\* | 4.7 | 18.0 |  | 5.0 | 25.3 |  |
| HR (95% CI) | 1.00 | 1.79 (1.35-2.36) |  | 1.00 | 1.62 (1.30-2.02) | 0.926 |
| **Arm muscle quality** |  |  |  |  |  |  |
| Person-years | 30,975 | 7,406 |  | 41,020 | 10,355 |  |
| No. of death | 167 | 111 |  | 257 | 204 |  |
| Crude mortality\* | 5.4 | 15.0 |  | 6.3 | 19.7 |  |
| HR (95% CI) | 1.00 | 1.35 (1.03-1.75) |  | 1.00 | 1.45 (1.18-1.79) | 0.595 |

HR=hazard ratio; CI=confidence interval.

Models were adjusted for the same variables as model 3 of Table 2.

\* Per 1000 person-years.

**Supplementary Table 6: Associations of muscle mass indices, grip strength, and arm muscle quality with all-cause mortality by total levels of physical activities**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameters | **Low levels of physical activity** | |  | **High levels of physical activity** | | ***P*int** |
| **Normal** | **Low** |  | **Normal** | **Low** |
| **Muscle mass indices** | | | | | | |
| **Appendicular muscle mass index** | | | | | | |
| Person-years | 33,995 | 10,339 |  | 38,043 | 7,378 |  |
| No. of death | 324 | 235 |  | 141 | 39 |  |
| Crude mortality\* | 9.5 | 22.7 |  | 3.7 | 5.3 |  |
| HR (95% CI) | 1.00 | 1.39 (1.15-1.68) |  | 1.00 | 0.97 (0.65-1.44) | 0.010 |
| **Total muscle mass index** |  |  |  |  |  |  |
| Person-years | 34,243 | 10,091 |  | 37,732 | 7,690 |  |
| No. of death | 348 | 211 |  | 132 | 48 |  |
| Crude mortality\* | 10.2 | 20.9 |  | 3.5 | 6.2 |  |
| HR (95% CI) | 1.00 | 1.36 (1.13-1.64) |  | 1.00 | 1.41 (0.97-2.04) | 0.862 |
| **Arm muscle mass index** | | | | | | |
| Person-years | 34,040 | 10,294 |  | 37,672 | 7,750 |  |
| No. of death | 315 | 244 |  | 133 | 47 |  |
| Crude mortality\* | 9.3 | 23.7 |  | 3.5 | 6.1 |  |
| HR (95% CI) | 1.00 | 1.62 (1.34-1.96) |  | 1.00 | 1.27 (0.87-1.85) | 0.094 |
| **Leg muscle mass index** | | | | | | |
| Person-years | 33,864 | 10,470 |  | 37,957 | 7,465 |  |
| No. of death | 334 | 225 |  | 141 | 39 |  |
| Crude mortality\* | 9.9 | 21.5 |  | 3.7 | 5.2 |  |
| HR (95% CI) | 1.00 | 1.23 (1.01-1.48) |  | 1.00 | 0.96 (0.64-1.43) | 0.023 |
| **Trunk muscle mass index** | | | | | | |
| Person-years | 34,503 | 9,831 |  | 37,468 | 7,953 |  |
| No. of death | 361 | 198 |  | 132 | 48 |  |
| Crude mortality\* | 10.5 | 20.1 |  | 3.5 | 6.0 |  |
| HR (95% CI) | 1.00 | 1.56 (1.27-1.91) |  | 1.00 | 1.55 (1.04-2.30) | 0.652 |
| **Grip strength** | | | | | | |
| Person-years | 32,325 | 12,009 |  | 39,938 | 5,484 |  |
| No. of death | 217 | 342 |  | 134 | 46 |  |
| Crude mortality\* | 6.7 | 28.5 |  | 3.4 | 8.4 |  |
| HR (95% CI) | 1.00 | 1.93 (1.58-2.35) |  | 1.00 | 0.99 (0.67-1.47) | 0.005 |
| **Arm muscle quality** | | | | | | |
| Person-years | 32,834 | 11,500 |  | 39,160 | 6,261 |  |
| No. of death | 291 | 268 |  | 133 | 47 |  |
| Crude mortality\* | 8.9 | 23.3 |  | 3.4 | 7.5 |  |
| HR (95% CI) | 1.00 | 1.50 (1.25-1.80) |  | 1.00 | 1.15 (0.79-1.67) | 0.370 |

HR=hazard ratio; CI=confidence interval.

Models were adjusted for the same variables as model 3 of Table 2, except for physical activities.

\* Per 1000 person-years.

**Supplementary Table 7: Associations of muscle mass indices, grip strength, and arm muscle quality with all-cause mortality by levels of leisure physical activities**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Parameters | **Without leisure physical activities** | |  | **With leisure physical activities** | | ***P*int** |
| **Normal** | **Low** |  | **Normal** | **Low** |
| **Muscle mass indices** | | | | | | |
| **Appendicular muscle mass index** |  |  |  |  |  |  |
| Person-years | 46,558 | 11,775 |  | 25,480 | 5,943 |  |
| No. of death | 287 | 197 |  | 178 | 77 |  |
| Crude mortality\* | 6.2 | 16.7 |  | 7.0 | 13.0 |  |
| HR (95% CI) | 1.00 | 1.39 (1.13-1.71) |  | 1.00 | 1.14 (0.85-1.55) | 0.190 |
| **Total muscle mass index** |  |  |  |  |  |  |
| Person-years | 46,734 | 11,599 |  | 25,241 | 6,182 |  |
| No. of death | 312 | 172 |  | 168 | 87 |  |
| Crude mortality\* | 6.7 | 14.8 |  | 6.7 | 14.1 |  |
| HR (95% CI) | 1.00 | 1.36 (1.10-1.66) |  | 1.00 | 1.61 (1.20-2.17) | 0.566 |
| **Arm muscle mass index** | | | | | | |
| Person-years | 46,651 | 11,682 |  | 25,060 | 6,362 |  |
| No. of death | 286 | 198 |  | 162 | 93 |  |
| Crude mortality\* | 6.1 | 17.0 |  | 6.5 | 14.6 |  |
| HR (95% CI) | 1.00 | 1.57 (1.28-1.93) |  | 1.00 | 1.59 (1.19-2.14) | 0.909 |
| **Leg muscle mass index** | | | | | | |
| Person-years | 46,411 | 11,922 |  | 25,410 | 6,013 |  |
| No. of death | 297 | 187 |  | 178 | 77 |  |
| Crude mortality\* | 6.4 | 15.7 |  | 7.0 | 12.8 |  |
| HR (95% CI) | 1.00 | 1.21 (0.98-1.49) |  | 1.00 | 1.13 (0.83-1.52) | 0.464 |
| **Trunk muscle mass index** | | | | | | |
| Person-years | 46,653 | 11,680 |  | 25,318 | 6,105 |  |
| No. of death | 320 | 164 |  | 173 | 82 |  |
| Crude mortality\* | 6.9 | 14.0 |  | 6.8 | 13.4 |  |
| HR (95% CI) | 1.00 | 1.60 (1.28-1.99) |  | 1.00 | 1.72 (1.25-2.39) | 0.978 |
| **Grip strength** | | | | | | |
| Person-years | 47,136 | 11,197 |  | 25,127 | 6,295 |  |
| No. of death | 218 | 266 |  | 133 | 122 |  |
| Crude mortality\* | 4.6 | 23.8 |  | 5.3 | 19.4 |  |
| HR (95% CI) | 1.00 | 1.72 (1.39-2.14) |  | 1.00 | 1.49 (1.10-2.00) | 0.215 |
| **Arm muscle quality** | | | | | | |
| Person-years | 47,187 | 11,146 |  | 24,807 | 6,615 |  |
| No. of death | 270 | 214 |  | 154 | 101 |  |
| Crude mortality\* | 5.7 | 19.2 |  | 6.2 | 15.3 |  |
| HR (95% CI) | 1.00 | 1.51 (1.23-1.86) |  | 1.00 | 1.17 (0.88-1.54) | 0.073 |

HR=hazard ratio; CI=confidence interval.

Models were adjusted for the same variables as model 3 of Table 2, except for physical activities.

\* Per 1000 person-years.

**Supplementary Table 8: Associations of muscle mass indices, grip strength, and arm muscle quality with all-cause mortality by body mass index**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | **BMI<24 kg/m2** | |  | **BMI≥24 kg/m2** | | ***P*int** |
| **Normal** | **Low** |  | **Normal** | **Low** |
| **Muscle mass indices** | | | | | | |
| **Appendicular muscle mass index** |  |  |  |  |  |  |
| Person-years | 27,477 | 16,909 |  | 44,561 | 809 |  |
| No. of death | 182 | 264 |  | 283 | 10 |  |
| Crude mortality\* | 6.6 | 15.6 |  | 6.4 | 12.4 |  |
| HR (95% CI) | 1.00 | 1.23 (1.00-1.52) |  | 1.00 | 0.99 (0.50-1.97) | 0.984 |
| **Total muscle mass index** |  |  |  |  |  |  |
| Person-years | 27,357 | 17,029 |  | 44,618 | 752 |  |
| No. of death | 196 | 250 |  | 284 | 9 |  |
| Crude mortality\* | 7.2 | 14.7 |  | 6.4 | 12.0 |  |
| HR (95% CI) | 1.00 | 1.34 (1.09-1.64) |  | 1.00 | 1.15 (0.56-2.34) | 0.995 |
| **Arm muscle mass index** | | | | | | |
| Person-years | 27,777 | 16,609 |  | 43,934 | 1,435 |  |
| No. of death | 173 | 273 |  | 275 | 18 |  |
| Crude mortality\* | 6.2 | 16.4 |  | 6.3 | 12.5 |  |
| HR (95% CI) | 1.00 | 1.64 (1.33-2.03) |  | 1.00 | 1.21 (0.71-2.08) | 0.577 |
| **Leg muscle mass index** | | | | | | |
| Person-years | 27,391 | 16,995 |  | 44,431 | 939 |  |
| No. of death | 195 | 251 |  | 280 | 13 |  |
| Crude mortality\* | 7.1 | 14.8 |  | 6.3 | 13.9 |  |
| HR (95% CI) | 1.00 | 1.03 (0.83-1.27) |  | 1.00 | 1.11 (0.60-2.04) | 0.393 |
| **Trunk muscle mass index** | | | | | | |
| Person-years | 28,820 | 15,566 |  | 43,151 | 2,219 |  |
| No. of death | 232 | 214 |  | 261 | 32 |  |
| Crude mortality\* | 8.1 | 13.8 |  | 6.1 | 14.4 |  |
| HR (95% CI) | 1.00 | 1.50 (1.20-1.86) |  | 1.00 | 1.56 (0.95-2.57) | 0.804 |
| **Grip strength** | | | | | | |
| Person-years | 34,415 | 9,971 |  | 37,848 | 7,521 |  |
| No. of death | 178 | 268 |  | 173 | 120 |  |
| Crude mortality\* | 5.2 | 26.9 |  | 4.6 | 16.0 |  |
| HR (95% CI) | 1.00 | 1.95 (1.55-2.45) |  | 1.00 | 1.33 (1.01-1.76) | 0.101 |
| **Arm muscle quality** | | | | | | |
| Person-years | 37,788 | 6,598 |  | 34,206 | 11,163 |  |
| No. of death | 273 | 173 |  | 151 | 142 |  |
| Crude mortality\* | 7.2 | 26.2 |  | 4.4 | 12.7 |  |
| HR (95% CI) | 1.00 | 1.60 (1.29-1.99) |  | 1.00 | 1.31 (1.02-1.70) | 0.180 |

HR=hazard ratio; CI=confidence interval.

Models were adjusted for the same variables as model 3 of Table 2.

\* Per 1000 person-years.

**Supplementary Table 9: Associations of muscle mass indices, grip strength, and arm muscle quality with all-cause mortality by waist circumference**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | **Waist circumference <85 (Male)/80(Female)** | |  | **Waist circumference ≥85 (Male)/80(Female)** | | ***P*int** |
| **Normal** | **Low** |  | **Normal** | **Low** |
| **Muscle mass indices** | | | | | | |
| **Appendicular muscle mass index** | | | | | | |
| Person-years | 22,051 | 13,518 |  | 49,987 | 4,199 |  |
| No. of death | 137 | 222 |  | 328 | 52 |  |
| Crude mortality\* | 6.2 | 16.4 |  | 6.6 | 12.4 |  |
| HR (95% CI) | 1.00 | 1.23 (0.97-1.57) |  | 1.00 | 1.01 (0.73-1.40) | 0.444 |
| **Total muscle mass index** | | | | | | |
| Person-years | 21,973 | 13,596 |  | 50,001 | 4,185 |  |
| No. of death | 148 | 211 |  | 332 | 48 |  |
| Crude mortality\* | 6.7 | 15.5 |  | 6.6 | 11.5 |  |
| HR (95% CI) | 1.00 | 1.28 (1.01-1.61) |  | 1.00 | 1.22 (0.87-1.69) | 0.761 |
| **Arm muscle mass index** | | | | | | |
| Person-years | 21,923 | 13,646 |  | 49,788 | 4,398 |  |
| No. of death | 122 | 237 |  | 326 | 54 |  |
| Crude mortality\* | 5.6 | 17.4 |  | 6.6 | 12.3 |  |
| HR (95% CI) | 1.00 | 1.58 (1.24-2.02) |  | 1.00 | 1.32 (0.96-1.82) | 0.327 |
| **Leg muscle mass index** | | | | | | |
| Person-years | 22,362 | 13,207 |  | 49,459 | 4,727 |  |
| No. of death | 153 | 206 |  | 322 | 58 |  |
| Crude mortality\* | 6.8 | 15.6 |  | 6.5 | 12.3 |  |
| HR (95% CI) | 1.00 | 1.05 (0.83-1.34) |  | 1.00 | 0.97 (0.72-1.33) | 0.818 |
| **Trunk muscle mass index** | | | | | | |
| Person-years | 22,890 | 12,680 |  | 49,082 | 5,104 |  |
| No. of death | 177 | 182 |  | 316 | 64 |  |
| Crude mortality\* | 7.7 | 14.4 |  | 6.4 | 12.5 |  |
| HR (95% CI) | 1.00 | 1.42 (1.12-1.80) |  | 1.00 | 1.56 (1.13-2.17) | 0.893 |
| **Grip strength** | | | | | | |
| Person-years | 27,615 | 7,954 |  | 44,648 | 9,538 |  |
| No. of death | 139 | 220 |  | 212 | 168 |  |
| Crude mortality\* | 5.0 | 27.7 |  | 4.8 | 17.6 |  |
| HR (95% CI) | 1.00 | 1.89 (1.46-2.43) |  | 1.00 | 1.43 (1.12-1.82) | 0.088 |
| **Arm muscle quality** | | | | | | |
| Person-years | 30,587 | 4,982 |  | 41,407 | 12,779 |  |
| No. of death | 227 | 132 |  | 197 | 183 |  |
| Crude mortality\* | 7.4 | 26.5 |  | 4.8 | 14.3 |  |
| HR (95% CI) | 1.00 | 1.61 (1.26-2.06) |  | 1.00 | 1.36 (1.09-1.71) | 0.195 |

HR=hazard ratio; CI=confidence interval.

Models were adjusted for the same variables as model 3 of Table 2.

\* Per 1000 person-years.

**Supplementary Table 10:. Associations of muscle mass indices, grip strength, and arm muscle quality with all-cause mortality by body fat percentage**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | **BF% <20% (male)/30% (female)** | |  | **BF% ≥20% (male)/30% (female)** | | ***P*int** |
| **Normal** | **Low** |  | **Normal** | **Low** |
| **Muscle mass indices** | | | | | | |
| **Appendicular muscle mass index** | | | | | | |
| Person-years | 28,527 | 11,966 |  | 43,511 | 5,752 |  |
| No. of death | 173 | 188 |  | 292 | 86 |  |
| Crude mortality \* | 6.1 | 15.7 |  | 6.7 | 15.0 |  |
| HR (95% CI) | 1.00 | 1.22 (0.97-1.53) |  | 1.00 | 1.27 (0.96-1.67) | 0.969 |
| **Total muscle mass index** | | | | | | |
| Person-years | 29,341 | 11,152 |  | 42,633 | 6,629 |  |
| No. of death | 192 | 169 |  | 288 | 90 |  |
| Crude mortality\* | 6.5 | 15.2 |  | 6.8 | 13.6 |  |
| HR (95% CI) | 1.00 | 1.30 (1.03-1.64) |  | 1.00 | 1.39 (1.07-1.82) | 0.967 |
| **Arm muscle mass index** | | | | | | |
| Person-years | 29,348 | 11,145 |  | 42,364 | 6,898 |  |
| No. of death | 172 | 189 |  | 276 | 102 |  |
| Crude mortality\* | 5.9 | 17.0 |  | 6.5 | 14.8 |  |
| HR (95% CI) | 1.00 | 1.55 (1.23-1.95) |  | 1.00 | 1.48 (1.14-1.93) | 0.522 |
| **Leg muscle mass index** | | | | | | |
| Person-years | 28,299 | 12,194 |  | 43,522 | 5,741 |  |
| No. of death | 182 | 179 |  | 293 | 85 |  |
| Crude mortality\* | 6.4 | 14.7 |  | 6.7 | 14.8 |  |
| HR (95% CI) | 1.00 | 1.02 (0.81-1.29) |  | 1.00 | 1.24 (0.94-1.63) | 0.360 |
| **Trunk muscle mass index** | | | | | | |
| Person-years | 30,581 | 9,912 |  | 41,391 | 7,872 |  |
| No. of death | 218 | 143 |  | 275 | 103 |  |
| Crude mortality\* | 7.1 | 14.4 |  | 6.6 | 13.1 |  |
| HR (95% CI) | 1.00 | 1.48 (1.16-1.90) |  | 1.00 | 1.67 (1.27-2.21) | 0.830 |
| **Grip strength** | | | | | | |
| Person-years | 32,665 | 7,828 |  | 39,598 | 9,664 |  |
| No. of death | 163 | 198 |  | 188 | 190 |  |
| Crude mortality\* | 5.0 | 25.3 |  | 4.8 | 19.7 |  |
| HR (95% CI) | 1.00 | 1.66 (1.29-2.14) |  | 1.00 | 1.73 (1.36-2.20) | 0.954 |
| **Arm muscle quality** | | | | | | |
| Person-years | 34,216 | 6,277 |  | 37,778 | 11,484 |  |
| No. of death | 220 | 141 |  | 204 | 174 |  |
| Crude mortality\* | 6.4 | 22.5 |  | 5.4 | 15.2 |  |
| HR (95% CI) | 1.00 | 1.58 (1.24-2.01) |  | 1.00 | 1.36 (1.08-1.70) | 0.374 |

BF%=body fat percentage; HR=hazard ratio; CI=confidence interval.

Models were adjusted for the same variables as model 3 of Table 2.

\* Per 1000 person-years.

# Members of the China Kadoorie Biobank collaborative group:

**International Steering Committee:** Junshi Chen, Zhengming Chen (PI), Robert Clarke, Rory Collins, Yu Guo, Liming Li (PI), Jun Lv, Richard Peto, Robin Walters. **International Co-ordinating Centre, Oxford:** Daniel Avery, Ruth Boxall, Derrick Bennett, Yumei Chang, Yiping Chen, Zhengming Chen, Robert Clarke, Huaidong Du, Simon Gilbert, Alex Hacker, Mike Hill, Michael Holmes, Andri Iona, Christiana Kartsonaki, Rene Kerosi, Ling Kong, Om Kurmi, Garry Lancaster, Sarah Lewington, Kuang Lin, John McDonnell, Iona Millwood, Qunhua Nie, Jayakrishnan Radhakrishnan, Paul Ryder, Sam Sansome, Dan Schmidt, Paul Sherliker, Rajani Sohoni, Becky Stevens, Iain Turnbull, Robin Walters, Jenny Wang, Lin Wang, Neil Wright, Ling Yang, Xiaoming Yang. **National Co-ordinating Centre, Beijing:** Zheng Bian, Yu Guo, Xiao Han, Can Hou, Jun Lv, Pei Pei, Chao Liu, Canqing Yu. **10 Regional Co-ordinating Centres: Qingdao CDC:** Zengchang Pang, Ruqin Gao, Shanpeng Li, Shaojie Wang, Yongmei Liu, Ranran Du, Yajing Zang, Liang Cheng, Xiaocao Tian, Hua Zhang, Yaoming Zhai, Feng Ning, Xiaohui Sun, Feifei Li. **Licang CDC:** Silu Lv, Junzheng Wang, Wei Hou. **Heilongjiang Provincial CDC:** Mingyuan Zeng, Ge Jiang, Xue Zhou. **Nangang CDC:** Liqiu Yang, Hui He, Bo Yu, Yanjie Li, Qinai Xu,Quan Kang, Ziyan Guo. **Hainan Provincial CDC:** Dan Wang, Ximin Hu, Jinyan Chen, Yan Fu, Zhenwang Fu, Xiaohuan Wang. **Meilan CDC:** Min Weng, Zhendong Guo, Shukuan Wu,Yilei Li, Huimei Li, Zhifang Fu. **Jiangsu Provincial CDC:** Ming Wu, Yonglin Zhou, Jinyi Zhou, Ran Tao, Jie Yang, Jian Su. **Suzhou CDC:** Fang liu, Jun Zhang, Yihe Hu, Yan Lu, , Liangcai Ma, Aiyu Tang, Shuo Zhang, Jianrong Jin, Jingchao Liu. **Guangxi Provincial CDC:** Zhenzhu Tang, Naying Chen, Ying Huang. **Liuzhou CDC:** Mingqiang Li, Jinhuai Meng, Rong Pan, Qilian Jiang, Jian Lan,Yun Liu, Liuping Wei, Liyuan Zhou, Ningyu Chen Ping Wang, Fanwen Meng, Yulu Qin,, Sisi Wang. **Sichuan Provincial CDC:** Xianping Wu, Ningmei Zhang, Xiaofang Chen,Weiwei Zhou. **Pengzhou CDC:** Guojin Luo, Jianguo Li, Xiaofang Chen, Xunfu Zhong, Jiaqiu Liu, Qiang Sun. **Gansu Provincial CDC:** Pengfei Ge, Xiaolan Ren, Caixia Dong. **Maiji CDC:** Hui Zhang, Enke Mao, Xiaoping Wang, Tao Wang, Xi zhang. **Henan Provincial CDC:** Ding Zhang, Gang Zhou, Shixian Feng, Liang Chang, Lei Fan. **Huixian CDC:** Yulian Gao, Tianyou He, Huarong Sun, Pan He, Chen Hu, Xukui Zhang, Huifang Wu, Pan He. **Zhejiang Provincial CDC:** Min Yu, Ruying Hu, Hao Wang. Tongxiang CDC: Yijian Qian, Chunmei Wang, Kaixu Xie, Lingli Chen, Yidan Zhang, Dongxia Pan, Qijun Gu. **Hunan Provincial CDC:** Yuelong Huang, Biyun Chen, Li Yin, Huilin Liu, Zhongxi Fu, Qiaohua Xu. **Liuyang CDC:** Xin Xu, Hao Zhang, Huajun Long, Xianzhi Li, Libo Zhang, Zhe Qiu.