L’OBESITÀ NELL’ANZIANO

JOURNAL CLUB - 7 SETTEMBRE 2018
ANDREA CRUCITTI
Overweight and obesity are defined as abnormal or excessive fat accumulation that presents a risk to health. A crude population measure of obesity is the body mass index (BMI), a person’s weight (in kilograms) divided by the square of his or her height (in metres). A person with a BMI of 30 or more is generally considered obese. A person with a BMI equal to or more than 25 is considered overweight.

Overweight and obesity are major risk factors for a number of chronic diseases, including diabetes, cardiovascular diseases and cancer. Once considered a problem only in high income countries, overweight and obesity are now dramatically on the rise in low- and middle-income countries, particularly in urban settings.
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<th>HEIGHT in/cm</th>
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Overweight and obesity are major risk factors for a number of chronic diseases, including diabetes, cardiovascular diseases and cancer. Once considered a problem only in high income countries, overweight and obesity are now dramatically on the rise in low- and middle-income countries, particularly in urban settings.

Highlight
Commission on Ending Childhood Obesity
Tasked with producing a report specifying which approaches and which combinations of interventions are likely to be most effective in different contexts around the world.

General information
Fact sheet on obesity and overweight

Technical information
Childhood overweight and obesity
Recommendations for healthy diets
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<th>WHO region</th>
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OBESITY
Excessive accumulation of adipose tissue
Obesity and Its Metabolic Complications: The Role of Adipokines and the Relationship between Obesity, Inflammation, Insulin Resistance, Dyslipidemia and Nonalcoholic Fatty Liver Disease

Un Ju Jung and Myung-Sook Choi *

Insulin resistance
Dyslipidemia

Type 2 Diabetes
Nonalcoholic Fatty Liver Disease

Altered glucose and lipid homeostasis

Chronic low-grade inflammation

ADIPOKINES

STORAGE
(energy from food intake)

ADIPOSE TISSUE

ENDOCRINE FUNCTION
Adipocyte
M2 macrophage
CD4+ T cell

Normal adipose tissue

M1 macrophage
CD8+ T cell
IFN-γ+ T cell

Enlarged adipose tissue

Anti-inflammatory adipokines
- Adiponectin
- SFRP5
- IL-10

FFA

Pro-inflammatory adipokines
- MCP-1
- Leptin
- SAA
- TNF-α
- Resistin
- ASP
- TGF-β
- PAI-1
- Angiotensin
- IL-1
- Visfatin
- IL-6
- RBP4
- IL-18
- ANGPTL2

Inflammation
Insulin resistance
Dyslipidemia
NAFLD
Other characteristics of the metabolic syndrome

Obesity and the Elderly

Elisabeth MH Mathus-Vliegen, MD, PhD
Obesity is a major public health problem. The population is growing older and the prevalence of obesity, even among older age group, is rising progressively.

Obesity (and the relative comorbidities and disabilities) may interfere with independency and activities of daily living and with quality of life.

Increased costs for its treatment and prevention are justified by a lesser need for medication, a lower need of nursing home admission and a better quality of the remaining life.
USA. Prevalence of obesity in elderly Americans (60 years and older) would increase from 32% in 2000 to 37.4% in 2010.

The Behavioural Risk Factor Surveillance System provided data on 52 921 subjects aged 65 years and older, 20.3% of whom were classified as being obese. In the age group 65 to 74 years, 25% had a BMI of ≥ 30 kg/m². 16.6% prevalence in the 75- to 84-year age group and 9.9% prevalence in the ≥ 85-year age group.

The Scottish Health Survey. Between 1998 and 2008, BMI continued to rise between age 60 and 70, especially in women. In that same period, waist circumference showed a 5 to 10 cm increase in both sexes at ages between 50 and 70 years.

France. In those aged 65 years or older the prevalence of obesity was 17.9% and similar in both sexes. With older age, the prevalence decreased from 19.5% in those aged 65 to 69 years to 13.2% in those aged 80 years and older. An increased waist circumference, ≥ 102 cm in males and ≥ 88 cm in females, was present in 47.6% of subjects.

Spain. 35% of subjects aged 65 years or older suffered from obesity (30.6% of males and 38.3% of females) and 61.6% had an increased waist circumference (50.9% of males ≥ 102 cm and 69.7% of females ≥ 88 cm).

Netherlands. Obesity was present in 18% of men and 20% of women aged 60 years or older, whereas 40% of men and 56% of women had an increased waist circumference (≥ 102 cm for men and ≥ 88 cm for women).
Sistema di sorveglianza che fornisce informazioni sulle **condizioni di salute, abitudini e stili di vita** della popolazione con 65 e più anni del nostro Paese.  
*Misura il contributo che gli anziani offrono alla società.*

**PERIODO:** Marzo 2012 / Gennaio 2013.

**DOVE:** 18 Regioni italiane e PA di Trento.

**COME:** 24.000 interviste, telefoniche o faccia a faccia, a operatori del sistema socio-sanitario, agli anziani e alle loro famiglie. Questionario standardizzato, messo a punto dall’Istituto Superiore di Sanità. Operatori appositamente formati. Campionamento casuale da assistiti ASL. Informazioni sono raccolte in maniera anonima.

http://www.epicentro.iss.it/passi-argento/
Chiunque potrà conoscere, consultando il sito, le condizioni degli ultra 65enni della Regione o Azienda sanitaria partecipante.

*Passi d’Argento* seguirà nel tempo qualità di vita percepita, aspetti sociali, sanitari e ambientali. Mettere a disposizione informazioni che possano promuovere le condizioni di vita.

*Migliori condizioni di salute, ↓ costi socio-sanitari, ↑ risorse per famiglie e comunità.*

Monitoraggio e valutazione piani sanitari e di prevenzione. Raccolta dati periodica (ogni 1-2 anni). Possibile confronto ASL all’interno di una stessa regione, ma anche stessa ASL nel tempo.
Sovrappeso e obesità

- La maggior parte delle persone ultra 64enni (57%) risulta in eccesso ponderale, il 42% risulta in sovrappeso e il 15% risulta obeso.
- L’eccesso ponderale (sovrapeso o obesità), fra gli anziani si riduce all’aumentare dell’età: fra i 65-74enni riguarda il 62% delle persone, scende al 56% fra i 75-84enni e al 44% negli ultra84enni.
- L’eccesso di peso appare significativamente più frequente nelle classi socioeconomiche più svantaggiate; tra ultra 64enni con basso livello istruzione è pari al 60% (43% in sovrappeso e 17% obesi), fra chi dichiara di avere molte difficoltà economiche risulta in eccesso ponderale il 63% (44% in sovrappeso e 19% obesi).
- Gli anziani in eccesso ponderale hanno profili di salute più critici rispetto alla popolazione generale: sono più frequentemente ipertesi (65% vs 60%), diabetici (24% vs 20%).
- L’analisi regionale evidenzia, come accade per gli adulti, un chiaro gradiente Nord-Sud che mostra fra i residenti nelle Regioni meridionali quote più alte di anziani in sovrappeso o obesi.

Il calo ponderale fisiologico

- Superati i 75 anni di età, l’indice di massa corporea è comunque soggetto a variazioni legate a fattori biologici e patologici e se all’aumentare dell’età si riduce la quota di anziani in eccesso ponderale, aumenta progressivamente la quota di persone che perdono peso indipendentemente dalla loro volontà.
- La percentuale di anziani che perdono peso (riduzione maggiore del 5% del peso iniziale o maggiore di 4,5 kg rilevata negli ultimi 12 mesi) indipendentemente dalla loro volontà è pari all’11% fra i 65-74enni, 15% tra i 75-84enni e 18% fra gli over 85enni.
- Questo aspetto, che è un fattore potenzialmente fragilizzante, si verifica più spesso nelle donne (15% vs 12% negli uomini) e tra coloro che hanno molte difficoltà economiche (16% vs 10% fra chi dichiara di non avere difficoltà economiche).
Eccesso ponderale
Prevalenze per caratteristiche socio-demografiche – PDA 2012

Popolazione di riferimento: 12.370.822
Totale: 57% (IC 95%: 56,31-58,17)

Età
- 65-74: 3.622.177 (61%)
- 75-84: 2.563.234 (56%)
- 85 e più: 835.030 (45%)

Sesso
- uomini: 3.483.623 (64%)
- donne: 3.602.383 (52%)
Eccesso ponderale
Prevalenze per caratteristiche socio-demografiche – PDA 2012

Popolazione di riferimento: 12.370.822

Totale: 57% (IC 95%: 56,31-58,17)

Istruzione
- bassa: 60%
- alta: 54%

Diff. economiche
- molte: 63%
- qualche: 60%
- nessuna: 54%

Patologie croniche*
- 3 o più patologie: 62%
- 1 o 2 patologie: 59%
- nessuna: 54%
Salute delle persone in eccesso ponderale
Prevalenze di patologia per eccesso ponderale - PDA 2012

- Ipertensione: 65% (sovrappeso/obesi) vs 60% (popolazione generale)
- Insufficienza renale: 11% (sovrappeso/obesi) vs 10% (popolazione generale)
- Diabete: 24% (sovrappeso/obesi) vs 20% (popolazione generale)
- Infarto: 14% (sovrappeso/obesi) vs 13% (popolazione generale)
- Malattie respiratorie: 25% (sovrappeso/obesi) vs 24% (popolazione generale)
Eccesso ponderale
Prevalenze per Regione di residenza - PDA 2012
Valore di pool: 57,2% (IC 95% 56,3-58,2%)

* Lombardia, Fvg e Marche hanno partecipato solo con una Azienda.
Il profilo di salute delle persone in eccesso ponderale residenti nella Azienda Sanitaria Universitaria Integrata di Trieste: i dati 2013-2016 dei sistemi di sorveglianza

Prevalenza di persone in eccesso ponderale per classi d’età
ASUITS (OKkio 2016- PASSI 2013-2016- PASSI D’Argento 2016)
In Europe, the prevalence of obesity increases with age to peak at about 60 years. Thereafter, body weights change little and begin to decline in older age.

The Scottish Health Survey, 1998-2008

- The overall prevalence of obesity showed little increase;
- BMI continued to rise \textit{(slowly)} between age 60 and 70, especially in women;
- Waist circumference showed a 5 to 10 cm increase in both sexes at ages between 50 and 70 years.

This \textit{disproportionate increase in waist circumference with a smaller increase in BMI} may indicate:

1) \textit{gain in visceral fat mass}
2) \textit{loss of lean tissue}
AGEING AND CHANGES IN
BODY COMPOSITION AND METABOLISM

AGE 20-70
Progressive decrease of fat-free mass (mainly muscle) of 40% whereas fat mass rises with age
Loss of muscle mass more evident at the end of the 5th decade for both sexes, but women gain greater fat mass

AFTER 70
Fat-free mass and fat mass decrease in parallel

Mathus-Vliegen EM. J Clin Gastroenterol, 2012; 46: 533 - 44
 Increase in visceral fat (more marked in women)
Increasingly deposited in skeletal muscle and in the liver
Impaired insulin action through locally released free fatty acids
Increased pancreatic fat with declining b-cell function
Increase in visceral fat (more marked in women)
Impaired glucose tolerance
AGEING AND CHANGES IN
BODY COMPOSITION AND METABOLISM

METABOLIC CHANGES

DECREASED ENERGY EXPENDITURE WITH AGEING

Loss of skeletal muscle

Decline of basal metabolic rate

Decreased intensity and duration of physical activity

Decreased postprandial energy expenditure (decreased fat oxidation)

2% to 3% per decade after age 20
4% per decade after age 50
(30% overall age 20 → 70)
ENERGY EXPENDITURE WITH AGEING

**AEE**: Activity energy expenditure; **FFM**: Fat-Free mass; **RMR**: Resting metabolic rate; **TEF**: Thermic effect of food

Johannsen DL and Ravussin E. Aging health. 2010; 6: 159–167
Come misuriamo l’obesità nell’anziano?
WHICH MEASURE OF ADIPOSITY BEST PREDICTS THE IMPACT OF OBESITY ON HEALTH OUTCOMES IN THE ELDERLY?

The relationship between BMI and disease risk is less close in the elderly than in younger people.

UNDERESTIMATION
Changes in body composition

OVERESTIMATION
Loss of height
WHICH MEASURE OF ADIPOSITY BEST PREDICTS THE IMPACT OF OBESITY ON HEALTH OUTCOMES IN THE ELDERLY?

WAIST CIRCUMFERENCE

Correlates highly with total fat and intraabdominal fat
Better predict adverse health effects of obesity in the elderly

The measurement should be made halfway between the iliac crest and the lower anterior ribs, with the patient standing, at the end of expiration.
PERCENT BODY FAT
(total weight of fat divided by total weight)

Dual-Energy X-ray Absorptiometry
Computed Tomography
Magnetic Resonance Imaging

THEY CAN DIFFERENTIATE
VISCERAL FROM SUBCUTANEOUS FAT

Only research purpose, relatively expensive

Bioelectrical Impedance devices

THEY CANNOT DIFFERENTIATE
VISCERAL FROM SUBCUTANEOUS FAT

Fast, easy, painless, and cheap

Bioelectrical impedance devices work well in healthy individuals with stable water balance
Percent body fat increases with age at every given BMI in both men and women.

BMI and all-cause mortality in older adults: a meta-analysis$^{1-3}$

Jane E Winter, Robert J MacInnis, Naiyana Wattanapenpaiboon, and Caryl A Nowson

**Background:** Whether the association between body mass index (BMI) and all-cause mortality for older adults is the same as for younger adults is unclear.

**Objective:** The objective was to determine the association between BMI and all-cause mortality risk in adults $\geq 65$ y of age.

**Design:** A 2-stage random-effects meta-analysis was performed of studies published from 1990 to 2013 that reported the RR of all-cause mortality for community-based adults aged $\geq 65$ y.

**Results:** Thirty-two studies met the inclusion criteria; these studies included 197,940 individuals with an average follow-up of 12 y. With the use of a BMI (in kg/m$^2$) of 23.0–23.9 as the reference, there was a 12% greater risk of mortality for a BMI range of 21.0–21.9 and a 19% greater risk for a range of 20.0–20.9 [BMI of 21.0–21.9; HR (95% CI): 1.12 (1.10, 1.13); BMI of 20.0–20.9; HR (95% CI): 1.19 (1.17, 1.22)]. Mortality risk began to increase for BMI $>33.0$ [BMI of 33.0–33.9; HR (95% CI): 1.08 (1.00, 1.15)]. Self-reported anthropometric measurements, adjustment for intermediary factors, and exclusion of early deaths or preexisting disease did not markedly alter the associations, although there was a slight attenuation of the association in never-smokers.

**Conclusions:** For older populations, being overweight was not found to be associated with an increased risk of mortality; however, there was an increased risk for those at the lower end of the recommended BMI range for adults. Because the risk of mortality increased in older people with a BMI $<23.0$, it would seem appropriate to monitor weight status in this group to address any modifiable causes of weight loss promptly with due consideration of individual comorbidities. *Am J Clin Nutr* 2014;99:875–90.

THE OBESITY PARADOX !!!
The association between \textit{all-cause mortality and BMI} for adults aged $\geq 65$ years forms a U-shaped curve, the risk of death rises at both extremes of BMI values (nadir between 24.0 and 30.9).
In older people, the effect of obesity is complex

The threshold value at which BMI confers mortality risk is higher in the elderly than for younger adults.

In this age group being overweight or obese is paradoxically associated with lower mortality rates from obesity-related diseases.

In young individuals obesity is primarily a risk for cardiometabolic disorders, but the function of fat mass as nutritional reserves becomes more important in advanced age.
THE BMI ALONE: IMPERFECT MEASURE OF OBESITY

THE SURVIVAL EFFECT
People who are susceptible to the negative effects of obesity die sooner, and those who survive until old age may be resistant to the effects of obesity.

UNHEALTHY WEIGHT LOSS
Smoking and diseases such as cancer that can cause early death may also induce weight loss, further complicating the relationship between BMI and death. After age 80, the association between BMI and the risk of death is weak because those with a low BMI include not only those who have always been lean and physically active, but also those who lost weight through chronic ill health or smoking.

REVERSE CAUSATION IN CARDIOVASCULAR DISEASES
...The disease itself is the cause of a low BMI and the associated worse prognosis.

HIGHER BMI, GREATER MUSCLE MASS
Better health of fitter elderly, whose greater weight and BMI reflects greater muscle mass.
Objective. Later life weight change and mortality amongst elders.

Design. Nested case–control study.

Setting. Six countries from the European Investigation into Cancer and nutrition – Elderly, Network on Ageing and Health.

Subjects. A total of 1712 deceased (cases) and 4942 alive (controls) were selected from 34,239 participants, ≥ 60 years at enrolment (1992–2000) who were followed-up until March 2007. Annual weight change was estimated as the weight difference from recruitment to the most distant from date-of-death re-assessment, divided by the respective time.

Outcome measures. Mortality in relation to weight change was examined using conditional logistic regression.

Results. Weight loss >1 kg year⁻¹ was associated with statistically significant increased death risk (OR = 1.65; 95% CI: 1.41–1.92) compared to minimal weight change (±1 kg year⁻¹). Weight gain >1 kg year⁻¹ was also associated with increased risk of death (OR = 1.15; 95% CI: 0.98–1.37), but this was evident and statistically significant only amongst overweight/obese (OR = 1.55; 95% CI: 1.17–2.05). In analyses by time interval since weight re-assessment, the association of mortality with weight loss was stronger for the interval proximal (<1 year) to death (OR = 3.10; 95% CI: 2.03–4.72). The association of mortality with weight gain was stronger at the interval of more than 3 years and statistically significant only amongst overweight/obese (OR = 1.58; 95% CI: 1.07–2.33). Similar patterns were observed regarding death from circulatory diseases and cancer.

Conclusions. In elderly, stable body weight is a predictor of lower subsequent mortality. Weight loss is associated with increased mortality, particularly short-term, probably reflecting underlying nosology. Weight gain, especially amongst overweight/obese elders, is also associated with increased mortality, particularly longer term.
What is the best threshold for high-risk WC in the population aged ≥ 70 years?

- Pain
- Self-reported mobility limitations
- Incontinence
- Cardiovascular disease
- Knee osteoarthritis
- Diabetes
- Health-related quality of life
Investigators prospectively took 4,996 measurements in 2,232 people with a mean age of 70, from 1992 through 2006. They concluded that the best cutoffs for predicting the health risks of obesity in the elderly were 109 cm (43 inches) in men and 98 cm (39 inches) in women.

Optimal cutoffs recommended for abdominal obesity for patients age 70 and older were 100 to 106 cm in men and less than 99 cm in women, both considering the shapes of the associations with important health outcomes and in terms of model fit.
Differential relationship between waist circumference and mortality according to age, sex, and body mass index in Korean with age of 30–90 years; a nationwide health insurance database study

Abstract

Background: A recent concept is that obesity, assessed by body mass index (BMI), is not always a sign of poor health. Thus, in order to use obesity metrics in clinical decision making, it is important to clarify the relationship between waist circumference (WC), a proxy for abdominal obesity, and mortality.

Methods: Data were used from 8,796,759 subjects aged between 30 and 90 years, who had participated in the Korea National Health Screening Examination between January 1, 2009 and December 31, 2009 and survived at least 1 year post screening. Data from a mean follow-up time of an additional 5.3 years (time at risk) were analyzed for the relationship between WC and mortality according to age, sex, and BMI category.

Results: An increased WC of more than 90 cm in men and 85 cm in women showed a definite negative influence on mortality. However, the detailed relationship between WC and mortality was J-shaped or U-shaped according to age, sex, and BMI category. In the normal BMI group, the optimal WC range with the lowest mortality was < 70 cm in men and 70–75 cm in women, whereas in obese individuals a WC between 80 and 90 cm in men and 75 and 85 cm in women showed the lowest mortality. The association between increased WC and higher mortality tended to be more obvious in normal-weight women than in normal-weight men or obese women. Furthermore, in normal-weight and obese women, the effect of increased WC on mortality was more critical for subjects aged < 60 years rather than those aged ≥ 60 years.

Conclusions: Abdominal obesity, as measured by WC, showed a significant negative association on mortality, and its association with mortality was different according to age, sex, and BMI category. Therefore, WC should be considered in the assessment of obesity-related health risks, and individualized cut-off points for the definition of a healthy WC according to age, sex, and BMI category are necessary.

Keywords: Obesity, Mortality, Body mass index, Waist circumference
The obesity paradox is a very controversial concept, because it can lead people to disregard the unhealthy metabolic consequences of excess adipose tissue.

The obesity paradox must not be confused with the limitation of BMI

**GENERAL OBESITY (BMI)**

It cannot fully reflect the risk of obesity-related metabolic complications and death

**VERSUS**

**CENTRAL OBESITY (WC)**

Central obesity measured using WC was more consistently related to higher mortality for cardiometabolic disturbances and certain cancers

**WC in combination with BMI is a better predictor of mortality than BMI alone**
Obesità nell’anziano e fragilità
OBESITY - PROS & CONS

- Decreased muscle mass and strength (sarcopenia)
- Increased joint dysfunction
- Chronic pain
- Unintentional injuries
- Disabilities of activities of daily living

FRAILTY

IMPAIRED QUALITY OF LIFE

…Leading to substantial morbidity and disability, increase in perceived discrimination, poor subjective health, lower life satisfaction and feelings of loneliness
Non solo complicanze metaboliche e cardiovascolari! Obesità e sovrappeso sono fattori di rischio anche per altre patologie croniche

- Osteoartrosi
- Cancro
- Decadimento cognitivo
- OSAS

Lo stato nutrizionale e le abitudini alimentari hanno un forte impatto sulla salute della popolazione mondiale: il World Cancer Research Fund International (WCRFI) ha documentato la relazione causale tra eccesso di peso e 7 forme di cancro: esofago, pancreas, colecistì, colon-retto, mammella (nel periodo postmenopausale), endometrio e rene.
L’Organizzazione per la Cooperazione e lo Sviluppo Economico (OCSE) ha stimato che una persona gravemente obesa perde in media 8-10 anni di vita, quanto un fumatore.

Per ogni 15 kg di peso in eccesso il rischio di morte prematura aumenta del 30%

L’obesità viene considerata responsabile di un incremento dell’età biologica
Obesity associated with increased brain age from midlife

Lisa Ronan a,*, Aaron F. Alexander-Bloch b, Konrad Wagstyl a, Sadaf Farooqi c, Carol Brayne d, Lorraine K. Tyler e, Cam-CAN e, Paul C. Fletcher a

ABSTRACT

Common mechanisms in aging and obesity are hypothesized to increase susceptibility to neurodegeneration, however, direct evidence in support of this hypothesis is lacking. We therefore performed a cross-sectional analysis of magnetic resonance image-based brain structure on a population-based cohort of healthy adults. Study participants were originally part of the Cambridge Centre for Ageing and Neuroscience (Cam-CAN) and included 527 individuals aged 20–87 years. Cortical reconstruction techniques were used to generate measures of whole-brain cerebral white-matter volume, cortical thickness, and surface area. Results indicated that cerebral white-matter volume in overweight and obese individuals was associated with a greater degree of atrophy, with maximal effects in middle-age corresponding to an estimated increase of brain age of 10 years. There were no similar body mass index-related changes in cortical parameters. This study suggests that at a population level, obesity may increase the risk of neurodegeneration.

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L’obesità può accelerare o far progredire le alterazioni correlate all’età, come la neurodegenerazione, sia direttamente che attraverso le associate comorbilità

<table>
<thead>
<tr>
<th>Variables</th>
<th>Lean</th>
<th>Overweight</th>
<th>Obese</th>
<th>$p$ for heterogeneity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BMI (kg/m²)</strong></td>
<td>18.5–24.99</td>
<td>25–29.99</td>
<td>≥30</td>
<td></td>
</tr>
<tr>
<td>(mean)</td>
<td>22.7 ± 1.7</td>
<td>27.1 ± 1.6</td>
<td>33.5 ± 3.8</td>
<td></td>
</tr>
<tr>
<td><strong>No. of subjects (%)</strong></td>
<td>246 (51)</td>
<td>150 (31)</td>
<td>77 (18)</td>
<td></td>
</tr>
<tr>
<td><strong>Sociodemographic variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>48 ± 16</td>
<td>57 ± 17</td>
<td>61 ± 16</td>
<td>$&lt;0.0001$</td>
</tr>
<tr>
<td>Female/male</td>
<td>122/124</td>
<td>66/84</td>
<td>49/28</td>
<td>$&lt;0.0001$</td>
</tr>
<tr>
<td>University degree or higher</td>
<td>180</td>
<td>89</td>
<td>33</td>
<td>$&lt;0.0001$</td>
</tr>
<tr>
<td>Household income (above median)</td>
<td>149</td>
<td>84</td>
<td>38</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Health behaviors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current smoking (%)</td>
<td>16</td>
<td>11</td>
<td>6</td>
<td>0.9</td>
</tr>
<tr>
<td>Physical activity (kJ/d/Kg)</td>
<td>47 ± 20</td>
<td>47 ± 22</td>
<td>43 ± 23</td>
<td>0.44</td>
</tr>
<tr>
<td><strong>Health measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic blood pressure (BP) (mm Hg)</td>
<td>116 ± 15</td>
<td>123 ± 16</td>
<td>126 ± 19</td>
<td>$&lt;0.0001$</td>
</tr>
<tr>
<td>Diastolic BP (mm Hg)</td>
<td>71 ± 10</td>
<td>75 ± 11</td>
<td>77 ± 11</td>
<td>$&lt;0.0001$</td>
</tr>
<tr>
<td><strong>Disease diagnosis</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>Cancer</td>
<td>11</td>
<td>6</td>
<td>9</td>
<td>0.03</td>
</tr>
<tr>
<td>Diabetes</td>
<td>3</td>
<td>6</td>
<td>9</td>
<td>$&lt;0.0001$</td>
</tr>
<tr>
<td>Stroke</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>High cholesterol</td>
<td>21</td>
<td>17</td>
<td>17</td>
<td>$&lt;0.01$</td>
</tr>
<tr>
<td>High BP</td>
<td>19</td>
<td>30</td>
<td>29</td>
<td>$&lt;0.001$</td>
</tr>
</tbody>
</table>
Questi risultati indicano che l'obesità ha un impatto sui cambiamenti strutturali cerebrali legati all'età

Il divario in "età cerebrale" è stato calcolato confrontando le differenze nel volume di sostanza bianca tra i gruppi nelle diverse età. Così a 50 anni, i soggetti obesi hanno un volume della loro materia bianca sovrapponibile a quello dei soggetti non obesi all'età di 60 anni.

L. Ronan et al. Neurobiology of Aging. 2016; 47: 63e70
**Non-linear dose–response relationship of BMI with impairment (cumulative effects)**

**Reverse causality? (increased food intake or reduced physical activity might also be the result of beginning cognitive impairment)**
Midlife overweight and obesity increase late-life dementia risk

A population-based twin study

ABSTRACT

Objective: The relation of overweight to dementia is controversial. We aimed to examine the association of midlife overweight and obesity with dementia, Alzheimer disease (AD), and vascular dementia (VaD) in late life, and to verify the hypothesis that genetic and early-life environmental factors contribute to the observed association.

Methods: From the Swedish Twin Registry, 8,534 twin individuals aged ≥65 (mean age 74.4) were assessed to detect dementia cases (DSM-IV criteria). Height and weight at midlife (mean age 43.4) were available in the Registry. Data were analyzed as follows: 1) unmatched case-control analysis for all twins using generalized estimating equation (GEE) models and 2) cotwin matched case-control approach for dementia-discordant twin pairs by conditional logistic regression taking into account lifespan vascular disorders and diabetes.

Results: Among all participants, dementia was diagnosed in 350 subjects, and 114 persons had questionable dementia. Overweight (body mass index [BMI] >25-30) and obesity (BMI >30) at midlife were present in 2,541 (29.8%) individuals. In fully adjusted GEE models, compared with normal BMI (20-25), overweight and obesity at midlife were related to dementia with odds ratios (ORs) (95% CIs) of 1.71 (1.30-2.25) and 3.88 (2.12-7.11), respectively. Conditional logistic regression analysis in 137 dementia-discordant twin pairs led to an attenuated midlife BMI-dementia association. The difference in ORs from the GEE and the matched case-control analysis was statistically significant (p = 0.019).

Conclusions: Both overweight and obesity at midlife independently increase the risk of dementia, AD, and VaD. Genetic and early-life environmental factors may contribute to the midlife high adiposity-dementia association. Neurology® 2011;76:1568-1574
<table>
<thead>
<tr>
<th>Characteristics</th>
<th>No dementia (n = 8,070)</th>
<th>Questionable dementia (n = 114)</th>
<th>Dementia (n = 350)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y, mean (SD)</td>
<td>74.0 (6.7)</td>
<td>80.5 (7.1)</td>
<td>82.3 (6.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Female sex</td>
<td>4,669 (57.9)</td>
<td>58 (50.9)</td>
<td>241 (68.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Education, y, mean (SD)</td>
<td>12.5 (62.3)</td>
<td>8.2 (2.9)</td>
<td>7.3 (2.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Midlife BMI, mean (SD)</td>
<td>23.7 (2.9)</td>
<td>24.9 (4.9)</td>
<td>25.0 (3.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Underweight (&lt;20)</td>
<td>610 (7.5)</td>
<td>6 (5.3)</td>
<td>11 (3.1)</td>
<td></td>
</tr>
<tr>
<td>Normal (20-25)</td>
<td>5,126 (63.5)</td>
<td>61 (53.5)</td>
<td>179 (51.1)</td>
<td></td>
</tr>
<tr>
<td>Overweight (25-30)</td>
<td>2,120 (26.3)</td>
<td>41 (36.0)</td>
<td>136 (38.9)</td>
<td></td>
</tr>
<tr>
<td>Obese (&gt;30)</td>
<td>214 (2.7)</td>
<td>6 (5.3)</td>
<td>24 (6.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Current BMI, mean (SD)</td>
<td>25.1 (3.7)</td>
<td>24.4 (3.6)</td>
<td>23.9 (4.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Diabetes</td>
<td>805 (10.0)</td>
<td>22 (19.3)</td>
<td>84 (24.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Stroke</td>
<td>621 (7.7)</td>
<td>35 (30.7)</td>
<td>103 (29.4)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Heart disease</td>
<td>1,111 (13.8)</td>
<td>48 (42.1)</td>
<td>245 (70.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hypertension</td>
<td>2,727 (33.8)</td>
<td>42 (36.8)</td>
<td>126 (36.0)</td>
<td>&gt;0.05</td>
</tr>
</tbody>
</table>

Odds ratio (OR) and 95% confidence interval (CI) of dementia and questionable dementia related to midlife body mass index (BMI), after adjustment for age, sex, education, zygosity, diabetes, stroke, hypertension, and heart disease (results from Multinomial Logistic Regression).
Obstructive Sleep Apnea Severity Affects Amyloid Burden in Cognitively Normal Elderly
A Longitudinal Study

Abstract

Rationale: Recent evidence suggests that obstructive sleep apnea (OSA) may be a risk factor for developing mild cognitive impairment and Alzheimer’s disease. However, how sleep apnea affects longitudinal risk for Alzheimer’s disease is less well understood.

Objectives: To test the hypothesis that there is an association between severity of OSA and longitudinal increase in amyloid burden in cognitively normal elderly.

Methods: Data were derived from a 2-year prospective longitudinal study that sampled community-dwelling healthy cognitively normal elderly. Subjects were healthy volunteers between the ages of 55 and 90, were nondepressed, and had a consensus clinical diagnosis of cognitively normal. Cerebrospinal fluid amyloid β was measured using ELISA. Subjects received Pittsburgh compound B positron emission tomography scans following standardized procedures. Monitoring of OSA was completed using a home sleep recording device.

Measurements and Main Results: We found that severity of OSA indices (AHIall \( F_{1,88} = 4.26; P < 0.05 \) and AHI4% \( F_{1,87} = 4.36; P < 0.05 \)) were associated with annual rate of change of cerebrospinal fluid amyloid β_{42} using linear regression after adjusting for age, sex, body mass index, and apolipoprotein E4 status. AHIall and AHI4% were not associated with increases in AD_{pib}-mask (Alzheimer’s disease vulnerable regions of interest Pittsburgh compound B positron emission tomography mask) most likely because of the small sample size, although there was a trend for AHIall \( F_{1,28} = 2.96, P = 0.09 \); and \( F_{1,28} = 2.32, \) not significant, respectively.

Conclusions: In a sample of cognitively normal elderly, OSA was associated with markers of increased amyloid burden over the 2-year follow-up. Sleep fragmentation and/or intermittent hypoxia from OSA are likely candidate mechanisms. If confirmed, clinical interventions for OSA may be useful in preventing amyloid build-up in cognitively normal elderly.

Keywords: obstructive sleep apnea; amyloid burden; Pittsburgh compound B positron emission tomography scan; cerebrospinal fluid amyloid β; cognitive impairment

Am J Respir Crit Care Med. 2018; 197: 933–943
Sarcopenic obesity and complex interventions with nutrition and exercise in community-dwelling older persons – a narrative review
SARCOPENIA

Loss of skeletal muscle mass and muscle function (strength or performance) higher than normal age-dependent changes

SARCOPENIC OBESITY

It is considered to be a combination of sarcopenia and obesity

PHYSICAL ACTIVITY

LOW-GRADE INFLAMMATION

MUSCLE CHANGES
Fig. 2 | MRI of individuals with and without obesity. Cross-sectional MRI of the quadriceps area of an individual without obesity with normal muscle characteristics (part a) and an individual with obesity with small muscles and infiltration by adipose tissue (part b) is shown. More muscle tissue is visible in part a than in part b, and the higher intensity signals seen in part b indicate fat infiltration of the muscle.
Socioeconomic determinants of sarcopenic obesity and frail obesity in community-dwelling older adults: The Seniors-ENRICA Study

It has been postulated that the synergistic association between sarcopenia and obesity may potentiate the effects of both syndromes separately, playing a probable role in the increased risk of cardiovascular disease and even of mortality.

Although frailty is considered a wasting disorder, it can coexist with obesity as “frail obesity”.

Lower educational level, having worked in manual jobs, and having poor housing conditions were associated with frail obesity. Having at least one social disadvantage throughout life substantially increased the prevalence of having frail obesity.

The likelihood of suffering from frail obesity was increased by 1.49 times for each social disadvantage added. Likewise, having 3 or 4 social disadvantages obtained an OR of 3.13 (95% CI: 1.71–5.70) when comparing to 0 or 1 disadvantages.

Summary
Eating alone has been an emerging social concern in modern life. However, there is little research on the association between eating alone and metabolic syndrome (MetS).

We aimed to assess the association between eating alone and the MetS and to identify whether sociodemographic factors modify this association.

This study included 7725 adults (≥19 years) who participated in the Korean National Health and Nutrition Examination Survey (KNHANES) 2013–2014. Multivariable logistic regression analysis was used for assessing the association of eating alone (none, 1 time/day, and ≥2 times/day) with MetS.

The percentages of subjects with MetS were 30.4% in men and 24.2% in women. 20.8% of men and 29.2% of women ate alone ≥2 times/day. Individuals who ate alone 2 or more times per day showed higher frequency of living alone, having no spouse, skip meals, and less eating out (p < 0.05). Women with eating alone ≥2 times/day had a crude OR of 1.29 (95% CI: 1.08–1.53, p-trend = 0.001) for MetS compared with women without eating alone. However, this association was no longer significant after adjustments for confounding factors. Eating alone ≥2 times/day was significantly associated with increase abdominal obesity (OR, 95% CI: 1.45, 1.10–1.91, p-trend = 0.039) and MetS (1.64, 1.28–2.10, p-trend = 0.004) in men. Eating alone was associated with a higher likelihood of having a MetS in men without spouse as compared with those with spouse (OR for men without spouse 3.02, 95% CI: 1.50–6.11 and OR for men with spouse 1.48, 95% CI: 1.22–1.7, p-interaction = 0.027).

Our results indicate that eating alone may be a potential risk factor for MetS.

The obesity prevalence in nursing homes is also already a common problem. A multistate study of newly admitted nursing home residents found an alarming 30% of adults aged 65 and older to have a BMI of $\geq 35$. Almost 30% of US nursing homes reported that 15% to 20% of the residents within the nursing homes were obese.

**Obesity and weight gain increase the relative risk (RR) of nursing home admission for community dwelling older adults**

For those aged 65 to 74 years the risk of admission increased by 31%

Those who were over-weight and experienced a significant weight gain were 2 times as likely to be admitted to a nursing home

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Mathus-Vliegen EM. J Clin Gastroenterol, 2012; 46: 533 - 44
The High Price of Obesity in Nursing Homes

Cindy L. Marihart, MA, PhD(c)
Ardith R. Brunt, PhD, RD
Angela A. Geraci, MPH, PhD(c), CHES
Department of Health Nutrition and Exercise Sciences, North Dakota State University

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Nursing home residents who are obese have different care needs and challenges than normal weight residents.

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Obesity is very difficult to treat but is identified as the most important modifiable risk factor after smoking.
Obesity and intensive staffing needs of nursing home residents

John Alexander Harris, MD, MSc a,*, John Engberg, PhD b, Nicholas George Castle, PhD c

ABSTRACT

The objective of this study is to examine how increasing body mass index (BMI) among nursing home residents affects the amount of staffing assistance needed for activities of daily living (ADL). We analyzed 1,627,141 US nursing home residents reported in the 2013 Minimum Data Set in seven BMI categories, from underweight (BMI < 18.5 kg/m²) to obesity Class IIIIB (≥ 50 kg/m²). Logistic regression models estimated the odds of nursing home-reported need for extensive (> 2 staff member) assistance needed for ADLs. The adjusted odds increased from 1.07 (95% Confidence Interval [95% CI] 1.05–1.09) for Class I, 1.16 (95% CI 1.14–1.18) for Class II, 1.33 (95% CI 1.31–1.35) for Class IIIA, and 1.90 (95% CI 1.86–1.95) for Class IIIIB obesity residents compared to residents of normal weight. As a nursing home resident’s BMI increases, especially for BMI ≥ 40 kg/m², the need for extensive staffing assistance with ADLs also increases substantially.

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Fig. 1. Probability of Resident Needing Two-person or More Assistance for Any Activity of Daily of Living.
Quali interventi?
Obesity and weight management in the elderly: A focus on men

The rising rate of overweight obesity among the ever-growing ageing population is imposing massive and rapidly changing burdens of ill health. The observation that the BMI value associated with the lowest relative mortality is slightly higher in older than in younger adults, mainly through its reduced impact on coronary heart disease, has often been misinterpreted that obesity is not as harmful in the elderly, who suffer a large range of disabling consequences of obesity. All medical consequences of obesity are multi-factorial and most alleviated by modest, achievable weight loss (5–10 kg) with an evidence-based maintenance strategy. But severe obesity, e.g. BMI >40 may demand greater weight loss e.g. >15 kg to reverse type 2 diabetes. Since relatively reduced physical activity and reduced muscle mass (sarcopenic obesity) are common in the elderly, combining exercise and modest calorie restriction optimally reduces fat mass and preserves muscle mass – age presents no obstacle and reducing polypharmacy is a valuable outcome. The currently licensed drug orlistat has no age-related hazards and is effective in a low fat diet, but the risks from bariatric surgery begin to outweigh benefits above age 60. For the growing numbers of obese elderly with diabetes, the glucagon-like peptide-1 (GLP-1) receptor analogue liraglutide appears a safe way to promote and maintain substantial weight loss.

Obesity and sarcopenia should be prevented from younger age and during life-transitions including retirement to improve future health outcomes and quality of life, with a focus on those in “obese families”.

INTERVENTIONS

Treatment should only be offered to patients who are obese rather than overweight and who have functional impairments, metabolic complications, or obesity-related diseases, that can benefit from weight loss.

DIET

The goal is to induce an energy deficit by reducing energy intake, increasing energy expenditure, or both—by 500 to 1,000 calories a day. This generally leads to a loss of up to 10% of weight in 6 months, with a relatively large reduction in visceral fat and subsequent improvement in metabolic abnormalities.
INTERVENTIONS

DIET

Treatment differs from that in the younger population primarily because of the importance of preventing loss of muscle and bone mass with intentional weight loss. People of all ages who lose weight intentionally lose fat and, to a lesser extent, skeletal muscle. Older patients have already lost muscle mass, but further changes in body composition, especially a further reduction in muscle mass, can be limited by consuming about 1.0 g/kg of high-quality protein in the diet and by engaging in resistance training and weight training. Very important is also an adequate intake of calcium and vitamin D.

In those who have survived into old age with good health and an intact functional status, significant caloric restriction should not be recommended. The goal is often to maintain weight and incorporate a daily exercise program rather than to aggressively lose weight. Weight regain is frequent, and this may be a disproportionate rise in body fat without restoring muscle or bone mass.
MULTICOMPONENT EXERCISE

A regular exercise program is important for improving overall physical function, which can improve quality of life and slow progression to frailty. Adding **aerobic, endurance, and resistance training** helps preserve fat-free mass, which otherwise tends to diminish during active weight loss. Multicomponent exercise includes flexibility training, balance training, aerobic exercise, and resistance training.

BARIATRIC SURGERY

The complications and negative impacts of bariatric surgery on quality of life increase above 60 years.
<table>
<thead>
<tr>
<th>Component</th>
<th>Goal</th>
<th>Suggested approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calorie restriction</td>
<td>Lose body fat and improve physical function</td>
<td>500–1,000 kcal per day</td>
</tr>
<tr>
<td></td>
<td></td>
<td>~0.5 kg per week aiming for 8–10% weight loss at 6 months followed by weight loss</td>
</tr>
<tr>
<td></td>
<td></td>
<td>maintenance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No specific diets are proven in this population</td>
</tr>
<tr>
<td>Aerobic exercises</td>
<td>Improve cardiorespiratory fitness</td>
<td>150 min per week of moderate to vigorous aerobic exercise</td>
</tr>
<tr>
<td>Resistance exercises</td>
<td>Improve muscle strength and mass; attenuate loss of muscle and bone</td>
<td>60–75 min of resistance training 3 times weekly, separated by one day focusing on</td>
</tr>
<tr>
<td></td>
<td>during weight loss efforts</td>
<td>strength, balance and flexibility</td>
</tr>
<tr>
<td>Protein supplementation</td>
<td>Mitigate loss of muscle mass and strength</td>
<td>1.0–1.2 g/kg per day of protein in divided doses (25–30 g daily)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5–2.8 g leucine daily</td>
</tr>
<tr>
<td>Calcium supplementation</td>
<td>Prevent potential disturbances in bone metabolism</td>
<td>1,200 mg per day of supplemental calcium, preferably through dietary measures</td>
</tr>
<tr>
<td>Vitamin D supplementation</td>
<td>Prevent potential disturbances in bone metabolism</td>
<td>1,000 IU vitamin D per day, ideally maintaining blood levels ≥30 ng/ml</td>
</tr>
</tbody>
</table>

**INTERVENTIONS**

**DRUGS**

**Orlistat (Xenical)** is the only evidence-based and licensed anti-obesity medication. It is a saturated derivative of lipostatin which acts by binding to intestinal lipases to prevent dietary fat absorption. There is no evidence to suppose that its effectiveness or safety would be any different in elderly patients, as it is not absorbed by the gastrointestinal tract. About 10% weight loss after one year may be achieved. Steatorrhoea is the main adverse effect (more troublesome in the elderly who may already suffer from faecal incontinence). Fat soluble vitamins, especially vitamin D, may be reduced substantially by orlistat.

**Sibutramine (Reductil)** is a centrally acting, monoamine reuptake inhibitor, blocking the reuptake of both serotonin and noradrenaline leading to increased satiation. It has recently been withdrawn in most countries.
## INTERVENTIONS

Avoid if possible drugs causing weight gain

<table>
<thead>
<tr>
<th>Medication group</th>
<th>Medication causing weight gain</th>
<th>Alternative medication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment for diabetes</td>
<td>sulfonylureas, thiazolidinediones, meglinites, insulin</td>
<td>α-glucosidase inhibitor, metformin, DDP-4 inhibitors, GLP-1 receptor agonists</td>
</tr>
<tr>
<td>Antidepressants</td>
<td>tricyclic antidepressants, mono-amine oxidase inhibitors, selective serotonin reuptake inhibitors (paroxetine)</td>
<td>fluoxetine, sertraline</td>
</tr>
<tr>
<td>Antipsychotics</td>
<td>clozapine, risperidon, olanzapine</td>
<td>no alternatives</td>
</tr>
<tr>
<td>Anticonvulsants</td>
<td>valproic acid, carbamazepine</td>
<td>topiramate</td>
</tr>
<tr>
<td>Antihypertensive drugs</td>
<td>β-blockers</td>
<td>ACE inhibitors</td>
</tr>
</tbody>
</table>

*Table 2. Medication resulting in weight gain and their potential alternatives*

Prevalence, Pathophysiology, Health Consequences and Treatment Options of Obesity in the Elderly: A Guideline

Elisabeth M.H. Mathus-Vliegen on behalf of the Obesity Management Task Force (OMTF) of the European Association for the Study of Obesity (EASO); members: Arnaud Basdevant, Nick Finer, Vojtech Hainer, Hans Hauner, Dragan Micic, Maximo Maislos, Gabriela Roman, Yves Schutz, Constantine Tsigos, Hermann Toplak, Volkan Yumuk, Barbara Zahorska-Markiewicz
<table>
<thead>
<tr>
<th>Benefits</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced risk for developing type 2 diabetes in subjects with impaired glucose tolerance</td>
<td>Potentially increased mortality risk with unintentional weight loss and less with intentional weight loss</td>
</tr>
<tr>
<td>Improved glycaemic, lipid and blood pressure control, reduced cardiovascular risk</td>
<td>Loss of muscle mass (sarcopenia) if not combined with regular exercise</td>
</tr>
<tr>
<td>Possibly reduced mortality risk from cardiovascular disease with intentional weight loss</td>
<td>Loss of mineral bone density, osteoporosis, and increased risk of fractures</td>
</tr>
<tr>
<td>Improved respiratory function and obstructive sleep apnoea control</td>
<td>Increased risk of specific protein and vitamin deficiencies</td>
</tr>
<tr>
<td>Improved functional capacity and ability of activities of daily living, reduced musculoskeletal co-morbidities</td>
<td>Increased risk of gallstone formation and cystitis (only in rapid weight loss)</td>
</tr>
<tr>
<td>Improved depressive symptoms, sense of well-being and quality of life</td>
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Fig. 2. Simplified schematic treatment strategy for obese elderly individuals.
Chronic Exercise Preserves Lean Muscle Mass in Masters Athletes

...This study evaluated whether high levels of chronic exercise prevents the loss of lean muscle mass and strength experienced in sedentary aging adults.

A cross-section of 40 high-level recreational athletes (“masters athletes”) who were aged 40 to 81 years and trained 4 to 5 times per week underwent tests of health/activity, body composition, quadriceps peak torque (PT), and magnetic resonance imaging of bilateral quadriceps. Mid-thigh muscle area, quadriceps area (QA), subcutaneous adipose tissue, and intramuscular adipose tissue were quantified in magnetic resonance imaging using medical image processing, analysis, and visualization software. One-way analysis of variance was used to examine age group differences. Relationships were evaluated using Spearman correlations. Mid-thigh muscle area (P = 0.31) and lean mass (P = 0.15) did not increase with age and were significantly related to retention of mid-thigh muscle area (P < 0.0001). This occurred despite an increase in total body fat percentage (P = 0.003) with age. Mid-thigh muscle area (P = 0.12), QA (P = 0.17), and quadriceps PT did not decline with age. Specific strength (strength per QA) did not decline significantly with age (P = 0.06). As muscle area increased, PT increased significantly (P = 0.008). There was not a significant relationship between intramuscular adipose tissue (P = 0.71) or lean mass (P = 0.4) and PT. This study contradicts the common observation that muscle mass and strength decline as a function of aging alone. Instead, these declines may signal the effect of chronic disuse rather than muscle aging. Evaluation of masters athletes removes disuse as a confounding variable in the study of lower-extremity function and loss of lean muscle mass. This maintenance of muscle mass and strength may decrease or eliminate the falls, functional decline, and loss of independence that are commonly seen in aging adults.

Chronic Exercise Preserves Lean Muscle Mass in Masters Athletes

"HOW DO YOU BUILD UP YOUR BANK ACCOUNT? BY PUTTING SOMETHING IN IT EVERY DAY. YOUR HEALTH ACCOUNT IS NO DIFFERENT. WHAT I DO TODAY, I AM WEARING TOMORROW. IF I PUT INFERIOR FOODS IN MY BODY TODAY, I'M GOING TO BE INFERIOR TOMORROW, IT'S THAT SIMPLE."

JACK LALANNE
1914 – 2011