REVIEW ARTICLE

Obesity in the elderly

Obesidade em idosos

Rodrigo Ribeiro dos Santos[1], Maria Aparecida Camargos Bicalho[1], Polyana Mota[2], Dirce Ribeiro de Oliveira[3], Edgar Nunes de Moraes[4]

DOI: 10.5935/2238-3182.20130011

[1] Adjunct Professor of the Internal Medicine Department, School of Medicine, Universidade Federal de Minas Gerais - UFMG. UFMG Center for Geriatrics and Gerontology. Belo Horizonte, MG – Brazil.
[2] Nutritionist. Centro Mais Vida at the Hospital das Clínicas, UFMG. Belo Horizonte, MG – Brazil.
[3] Professor of the Department of Nutrition at the School of Nursing, UFMG. Reference Center for the Elderly at the Hospital das Clínicas, UFMG. Belo Horizonte, MG – Brazil.
[4] Associate Professor of the Department of Internal Medicine, School of Medicine, UFMG. Coordinator of the UFMG Center for Geriatrics and Gerontology and of the Reference Center for the Elderly, Hospital das Clínicas, UFMG. Belo Horizonte, MG – Brazil.

ABSTRACT

Aging produces several changes in body composition. Aging is associated with an increase in body fat and changes in their distribution pattern. The risks associated with an increase in body fat or from low weight are different in the elderly. As a result, the World Health Organization recommends a modification in the Body Mass Index (BMI) in the elderly. The BMI cutoffs currently used to assess the nutritional status of the elderly are: underweight (BMI <22kg/m2), normal weight (BMI between 22 and 27kg/m2) and overweight (BMI> 27kg/m2). The prevalence of many complications associated with obesity – such as hypertension, diabetes mellitus, cardiovascular disease, some cancers, sleep apnea/hypopnea syndrome and osteoarthritis – also increases during the aging process. However, several studies have shown that overweight in elderly patients is not associated with increased mortality. Studies show that overweight reduces all-cause mortality among the elderly. This reduction is a paradox that contradicts evidences for other age groups. It should be noted, however, that sarcopenia associated with lower weight accounts for this increase in mortality. In obese patients a worrying picture is, therefore, the development of sarcopenic obesity. We thus conclude that weight control in the elderly has many peculiarities. Overweight is beneficial for the elderly, hence the adjustment in BMI values. Recognizing and managing comorbid conditions directly related to weight excess, at the same time, avoiding involuntary weight changes should be a priority in the care of the elderly.

Key words: Obesity; Aged; Body Mass Index; Health of the Elderly.

RESUMO

O envelhecimento determina diversas modificações na composição corporal. O envelhecimento está associado a aumento da massa gordurosa e mudanças no seu padrão de distribuição. Os riscos associados ao aumento da massa gordura ou decorrentes do baixo peso são diferentes nos idosos. Em decorrência disto, a Organização Mundial de Saúde recomenda uma alteração no Índice de Massa Corporal (IMC) em idosos. Os pontos de corte de IMC atualmente utilizados para a avaliação do estado nutricional de idosos são: baixo peso (IMC <22kg/m2), eutrofia (IMC entre 22 a 27kg/m2) e sobrepeso (IMC >27kg/m2). A prevalência de muitas complicações associadas à obesidade – como hipertensão arterial sistêmica, diabetes mellitus, doença cardiovascular certos tipos de câncer, síndrome de apnéia/hipopnéia do sono e osteoartrite – também aumenta durante o envelhecimento. Entretanto, vários estudos têm demonstrado que o sobrepeso em pacientes idosos não se associa com aumento da mortalidade geral. Estudos demonstram que o sobrepeso reduz a mortalidade por todas as causas em idosos. Esta redução gera um paradoxo ao ir contra as evidências em jovens. Deve-se salientar, contudo, que o aumento da mortalidade decorrente do baixo peso advém da sarcopenia. Nos pacientes obesos um quadro preocupante, portanto, é o desenvolvimento da obesidade sarcopêni-

Submitted: 02/11/2013
Approved: 03/15/2013

Institution:
Hospital das Clínicas da UFMG
Belo Horizonte, MG – Brazil

Corresponding Author:
Edgar Nunes de Moraes
E-mail: edgarnmoraes@gmail.com

ca. Conclui-se, então, que o controle de peso em idosos apresenta inúmeras particularidades. O sobrepeso é benéfico para os idosos, por isso o ajuste no valor do IMC. Nos pacientes obesos reconhecer e controlar os sintomas das comorbidades diretamente relacionadas com o excesso de peso assim como evitar ganhos ou perdas involuntárias de peso entre os idosos é uma prioridade.

Palavras-chave: Obesidade; Idoso; Índice de Massa Corporal; Saúde do Idoso.

INTRODUCTION

While aging is the greatest achievement of mankind, it brings some questions that remain unanswered. Because it is a recent phenomenon, some concepts of normality are not yet established. It is known that proper nutrition is essential to promote and maintain health, independence, and autonomy among the elderly. Parameters of normality differ in the various life cycles. Nutritional status may be defined as the health status of an individual that is affected by food intake, nutrient use and requirements. Thus, nutritional assessment is part of a multidimensional assessment of elders (Figure 1).

Body composition includes fat tissue, muscle, bone, and water, and is divided into two groups: lean mass (fat free and constituted by protein, intracellular and extracellular water, and bone mineral content) and fat mass (body fat). Aging results in several changes in body composition, usually without concomitant changes in body weight and body mass index (BMI). In addition to reducing body water, aging causes a reduction of 20-30% in muscle mass (sarcopenia) and bone mass (osteopenia/osteoporosis) caused by neuroendocrine changes (less renal responsiveness to ADH, reduction in the basal levels of aldosterone, reduction in growth and sex hormones, increase in parathyroid hormone, decrease in kidney function, in vitamin D, etc.) and physical inactivity. Sarcopenia contributes to the following changes in older adults[1]:

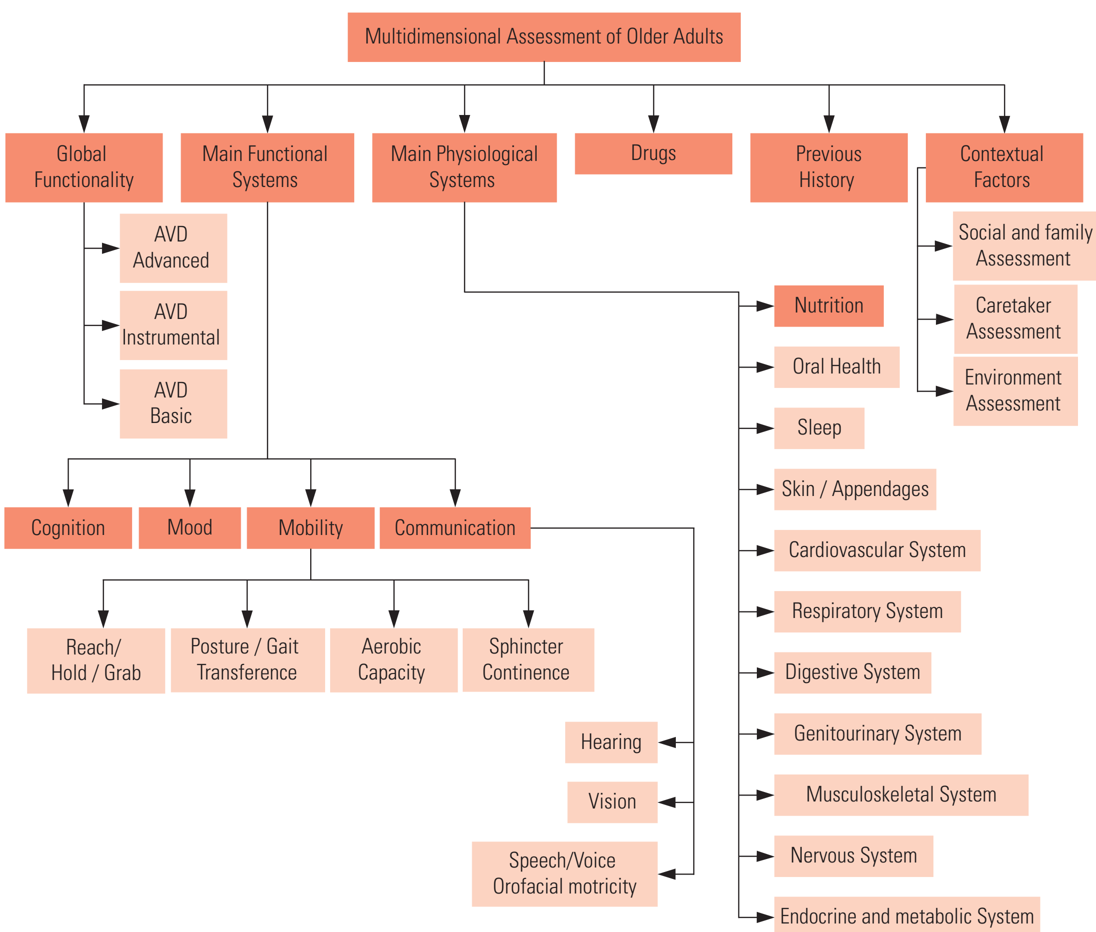

Figure 1 - Multidimensional Assessment of the Elderly.

- increased tendency to body weight loss in most organs;
- reduced muscle strength, mobility, balance, exercise tolerance, increased risk of falls, and immobility;
- less metabolically active tissues, leading to decreased basal metabolism (100 kcal/decade), which causes anorexia and consequent reduction in food consumption, and may cause protein-calorie malnutrition and micronutrient deficiencies, such as vitamin D, magnesium, calcium, and zinc;
- decreased insulin sensitivity: glucose intolerance;
- compromised immune response. [2,3]

Obesity is not just the increase in weight, but also excess body fat. Aging is associated with increased fat mass and changes in distribution pattern. There is a 20 to 30% increase in total body fat (2 to 5%/decade, after age 40) and distribution changes, with fat tending to accumulate in more central, abdominal, and visceral locations. Typically, women are more likely to undergo fat deposition in the viscera, gluteus, and thighs ("pear-shaped" physique) while in men fat is more commonly located in the abdominal region ("apple-shaped" physique). In addition to abdominal obesity, aging is associated with more infiltration of fatty tissue in the liver and muscles, which is, in turn, correlated with insulin resistance and glucose intolerance. Obesity and aging are characterized by a state of low-degree systemic inflammation that leads to loss of lean body mass, reduced immune function, cognitive decline, atherosclerosis, and insulin resistance. Most inflammatory substances, such as TNF-α and IL-6, have catabolic effects on skeletal muscle and are involved in sarcopenia, the involuntary loss of skeletal muscle mass with aging, resulting in reduced physical capacity, reduced mobility and fragility.[4]

Central and visceral obesity have a more pro-inflammatory character, when compared with global obesity.[5]

All these changes in body composition have clinical importance in how older adults function, given that they culminate in significant muscle reduction with increased total body fat, making elders more susceptible to mobility limitations.

Obesity causes relevant functional implications in the elderly population, since it can exacerbate the decline of physical functions associated with aging. Functional capacity impairment, particularly related to mobility, are significantly higher in overweight and obese older adults compared to eutrophic counterparts. When functional impairment and decreased physiological reserves are serious enough to determine disability, a process of fragility ensues, which in turn can lead to loss of independence, decreased quality of life and increased mortality.[6,7]

According to data from the National Health Examination Survey I (NHES) and National Health and Nutrition Examination Study (NHANES) I-III, the prevalence of obesity (BMI≥30 kg/m^2) is growing progressively in the elderly population. It has been estimated that it has increased among the American elderly aged 60 years or more from 23.6% in 1990 to 32.0% in 2000, and in 2010 it already included 37.4% of the population. This means an increase in the number of obese elderly from 9.9 million (1990) to 14.6 million (2000) and 20.9 million in 2010.[5]

BODY COMPOSITION AND ANTHROPOMETRY IN THE ELDERLY

Anthropometry in the elderly is an important nutritional indicator, but changes in body composition may influence the interpretation of results. Body weight and height measurements have limitations. The curving of the spine and vertebrae, in addition to difficulties to walk or stand, complicate these measurements.

Previous studies have described changes in body composition with aging, such as decreased water content, fat gain and decline in skeletal muscle mass. Several methods that are used for characterizing body composition, such as bioimpedance (BIA), ultrasound (US), computerized tomography (CT) and magnetic resonance imaging (MRI) can register these changes.

Currently, the most recommended method for assessing body composition is DEXA – dual X-ray absorptiometry, which can determine the percentage of fat and lean mass, serving as an additional tool in the assessment of cardiovascular risk. Advantages of these methods are convenience and the ability to take objective measures in a short time (20-30 minutes).

Despite the high accuracy of complementary methods, high cost and operational complexity limit the routine use of these approaches in the study of obesity. Anthropometric measurements represented by BMI, waist-hip ratio (WHR), calf circumference (CC) and abdominal circumference (AC) represent a rational and efficient way to assess volume and distribution of fat and muscle, and should be used in routine clinical practice. BIA is also a convenient, very simple, inexpensive, and non-invasive method to assess body composition in field studies and population surveys.[8]

Weight and height represent the most commonly available anthropometric variables, even if their combined use fails to distinguish fat from muscle mass or edema. According to the World Health Organization, body weight tends to increase up to the age of 60. Weight gain in males reaches its peak at age 65 and from then on there is a tendency for weight loss. Women reach that peak at age 75.[6] Weight loss from 65 years of age on, especially among men, may be associated with loss of muscle mass. There is, moreover, a decrease in height among older adults of about 1 cm (men) to 1.5 cm (women) per decade starting from 40 to 50 years of age. Bone mass decrease (osteopenia and/or osteoporosis) associated with thoracic hyperkyphosis, kyphoscoliosis and reduction of intervertebral discs (flattening) is the main determinant, particularly in women.[9] The use of calculation based on knee height is recommended to correct this loss in height, inherent to the aging process. Nevertheless, it is still rarely used in clinical practice.[10]

BMI is calculated based on height and body mass of an individual [BMI = weight (kg)/height (m^2)] and is considered a good predictor of body fat in adults. It is the diagnostic parameter for excess weight and obesity, although it cannot distinguish lean mass from fat tissue, besides other aspects of body composition, such as the distribution of visceral or subcutaneous fat. Thus, weight should be classified according to body mass index (BMI). BMI is the most widely used method to assess nutritional risk, but has limitations, especially for use in the elderly, and may underestimate the amount of fat mass, because it fails to assess body composition and distribution. Elders with similar BMI may have very different body compositions. Moreover, BMI may underestimate or overestimate the level of body fat.[5] (Figure 2)

In 1994, Lipschitz proposed a classification that considers the changes in body composition in older adults. The author recommends as an acceptable limit for this age group a BMI between 24 and 29 kg/m^2, with cutoff points for underweight and overweight, respectively, BMI below 22 kg/m^2 and above 27 kg/m^2.[11] The WHO, in 1995, based on the mortality risks associated with low BMI, defined the presence of low BMI as thinness or underweight and established the following cutoff points, according to the underweight degrees: grade I - mild thinness (BMI 17.0 to 18.49 kg/m^2); grade II - moderate thinness (BMI 16.0 to 16.99 kg/m^2) and grade III - severe thinness (BMI <16.0).

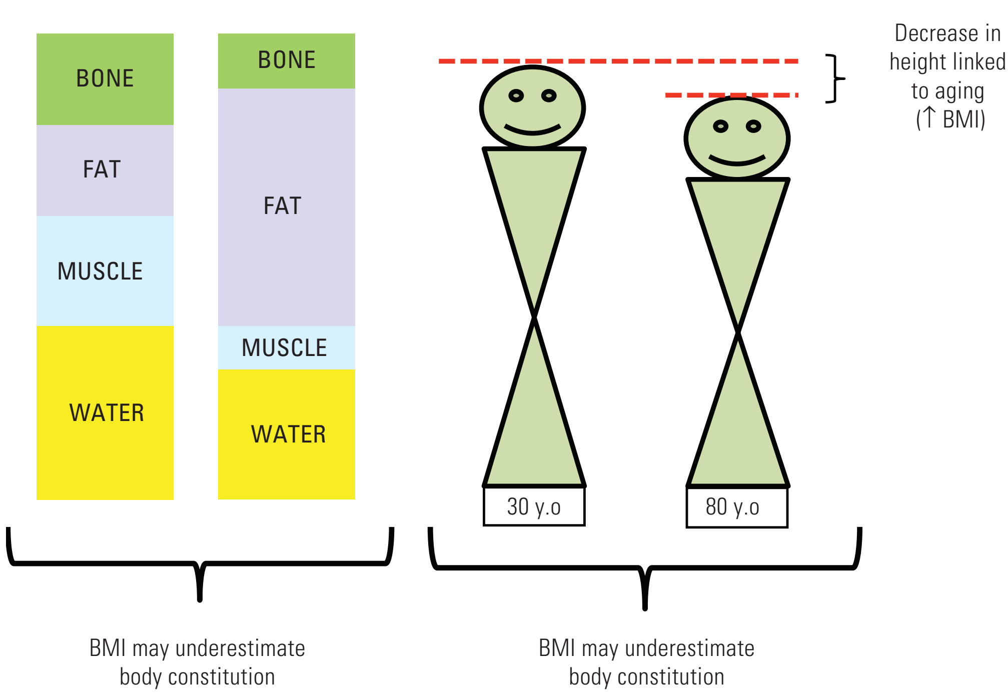

Figure 2 - BMI and Aging Dysfunctions.

These cutoff points, despite having been developed for adults, are often used to classify the nutritional status of the elderly. The BMI cutoffs currently used to assess the nutritional status of older adults are underweight (BMI < 22 kg/m^2), eutrophic (BMI between 22 and 27 kg/m^2) and overweight (BMI> 27 kg/m^2). This classification is different from that recommended for adults and considers the changes in body composition that occur with aging.[12]

BMI correlates well with the percentage of body fat determined by densitometry, BIA, skin folds, waist/hip ratio (WHR) and waist circumference (WC).

Circumferences

In cases that require more thorough body composition assessment, additional anthropometric data should be obtained. Circumferences are affected by fat mass, muscle mass and bone size. It is possible to measure a wide range of body circumferences, but the major circumferences used in clinical practice are:

- **calf circumference:** muscle mass and sarcopenia can be assessed by measuring calf circumference (CC). Sarcopenia - defined as "a condition in which muscle strength is insufficient to perform normal tasks associated with an independent lifestyle" - occurs due to involuntary loss of muscle mass. It may appear with advancing age and results in decreased strength and muscular endurance. It is significantly associated with the loss of independence. Thus, CC is a potential indicator of functional capacity. It is a simple, inexpensive and noninvasive measurement and seems to be relevant in the diagnosis of nutritional status, functional capacity and health status. A CC of less than 31 cm is considered the best clinical indicator of sarcopenia (sensitivity of 44.3%, specificity = 91.4%) and is related to functional disability and to the risk of falling given the crucial role of leg muscles, especially triceps surae and quadriceps, in mobility;
- **waist circumference:** is the best indicator of visceral adiposity (omental, mesenteric and muscle and liver infiltration) and, by consequence, of insulin resistance. Some studies show that waist circumference can be considered a more reliable independent predictor than BMI for metabolic and cardiovascular complications associated with obesity. Waist circumference (WC)/cm values considered as risk factors for diseases associated with obesity (Table 1):

Table 1 - Waist circumference

High Risk	Women ≥ 80	Men ≥ 94
Very High Risk	Women ≥ 88	Men ≥ 102

Source: World Health Organization, 1997

- waist to hip ratio (WHR) is strongly associated with visceral fat, being an acceptable intra-abdominal fat index. It is the most frequently used measurement of adiposity, and is able to distinguish gynecoid from android obesity. A WHR of 1.0 or more for men and 0.8 for women or more is indicative of android obesity and increased risk of diseases related to this disorder;
- arm circumference (ac) is widely used in combination with triceps skin fold (TSF) measurement because these combined measurements can, with the use of a specific formulae, be used to calculate arm muscle circumference (AMC) and arm muscle area (AMA), and muscle area without bone. These indices are correlated with total muscle mass and are used to diagnose dysfunctions in the total body muscle mass, and, thus, the protein nutritional status. The reserve of muscle tissue can be estimated by the arm muscle circumference (AMC) and calf circumference (CC). AMC, despite not taking into account the irregularity in shape of arm tissues, should be the standard indicator considering that Third National Health and Nutrition Examination Survey (NHANES III) provides reference data for that indicator.

OBESITY AND COMORBIDITIES IN THE ELDERLY

Obesity causes serious medical complications, with consequent increase in morbidity, impact on the quality of life, and premature death. The pathophysiologic processes involved include insulin resistance, lipid abnormalities, hormonal dysfunctions, and chronic inflammation. The prevalence of many complications associated with obesity – such as systemic arterial hypertension (SAH), diabetes mellitus, cardiovascular disease, some cancers, sleep apnea/hypopnea syndrome and osteoarthritis – also increases during the aging process. Thus, excess body weight may contribute to the development of diseases during the aging process. Sarcopenic obesity, and not just obesity and sarcopenia isolated, appears to be associated with increased cardiovascular risk in the elderly.[2,13-15] The term is used to describe the confluence of excess fat coexisting with a reduction in lean body mass, including muscle and bone. There is loss in quantity and quality of muscles, with reduction the number and size of muscle fibers, mitochondrial function, and muscle protein synthesis. Identifying older adults with sarcopenic obesity is clinically relevant but difficult. Muscle strength is more important than muscle mass in determining functional limitation and decline in overall health. Measurements of muscle strength using a dynamometer (handgrip) are easier, cheaper and more clinically relevant than measurements of muscle mass based on dual X-ray absorptiometry (DEXA), bioelectrical impedance analysis or computerized tomography.[5]

In the general population, overweight and obesity are known risk factors for developing cardiovascular diseases (CVD) such as heart failure, coronary artery disease (CAD), left ventricular hypertrophy (LVH), endothelial dysfunction, ventricular systolic and diastolic dysfunction and atrial fibrillation (AF). The prevalence of most cardiovascular risk factors related to obesity, such as hypertension and diabetes mellitus, increases with age.[6]

Overweight and obesity can cause overall mortality and incidence of premature death to increase and are associated with the development of cardiovascular risk factors. Most studies assessing obesity and cardiovascular risk factors, however, are performed in populations of younger rather than older adults.[6]

Studies in elderly populations have shown that central obesity is associated with the presence of cardiovascular risk factors such as hypertension, insulin resistance and type-2 diabetes, hypertriglyceridemia and low HDL-cholesterol.[16,17] The prevalence of metabolic syndrome increases with age and reaches its peak between 50 and 70 years of age for men, and 60 and 80 years of age for women.[18]

Fasting glucose increases by 1 to 2 mg/dL and postprandial glucose by 10 to 20 mg/dL per decade after age 30. As a consequence, the prevalence of type 2 diabetes increases in the elderly. Although the high prevalence of type-2 diabetes mellitus and glucose intolerance has been previously attributed to aging in isolation, more recent studies suggest that age-related insulin resistance is associated with abdominal obesity and inactivity and that elders who are physically active and show no increase in waist circumference are less predisposed to the development of type-2 diabetes mellitus (7). Thus, it is visceral obesity, and not aging in isolation, that could be responsible for reducing glucose tolerance as observed in elderly individuals.[19]

Systemic arterial hypertension (SAH) affects between 30 and 50% of the elderly. Among older adults, obesity and hypertension are correlated. The mechanisms involved include the direct effects of obesity in hemodynamics and factors associated with increased peripheral vascular resistance, such as endothelial dysfunction, insulin resistance, hyperactivity of the sympathetic nervous system, release of substances by adipocytes, and obstructive sleep apnea.[7,14]

Low levels of HDL-cholesterol and high triglyceride levels are associated with obesity in both young and elderly individuals.[7]

Most of the elderly patients presented with CVD and the majority of CVD patients is in that age group. The high prevalence of CVD in the elderly population is related to the mechanisms associated with elevated cardiovascular risk factors, such as dyslipidemia, SAH, glucose intolerance, hypoventilation/obstructive sleep apnea, and prothrombotic state. However, in addition to an altered metabolic profile, obese individuals develop various structural and functional cardiac adaptations/alterations, even in the absence of comorbidities. As a result, obesity is associated with numerous cardiovascular complications such as CAD, heart failure and sudden death.[6,14]

Obesity leads to increased metabolic demand caused by excess body weight, promoting an increase in total blood volume and cardiac output (CO). There is an increase in the volume and ventricular filling pressures, determining chamber expansion and eccentric LVH (increased mass with relative normal wall thickness). Left atrial enlargement is effected secondary to a physiological adaptation to expanded volume, to the hemodynamic effects of concomitant SAH, to LVH, and to diastolic dysfunction of the left ventricle. This atrial increase leads to high risk of developing atrial fibrillation, especially in the elderly. Obese individuals are at increased risk of arrhythmias and sudden death, even in the absence of myocardial dysfunction. There can be lipid accumulation in the cardiomyocytes, determining dysfunction and cell death. We call that phenomenon lipotoxicity.[14]

Endothelial cell dysfunction and/or vessel resistance and vessel wall inflammation are important events in the development of atherosclerosis. Central fat distribution is more important than total fat as a risk factor for atherosclerosis. Yet, the effects of adiposity and fat distribution in endothelial dysfunction seem to be less important in elders than in younger adults.[14,20]

Obstructive sleep apnea and alveolar hypoventilation are also more frequent in obese elderly. For patients with obstructive sleep apnea, obesity represents the main cause of respiratory insufficiency and pulmonary hypertension.[7]

Obesity is also associated with several types of cancers that are more common in the elderly than in younger adults, such as breast cancer, cancer of the intestines, gallbladder, pancreas, kidney, bladder, uterus, head and neck, and prostate cancer.[7]

Osteoarthrosis is the leading cause of disability among older adults. Obese elders also have increased risk of knee osteoarthrosis. Obesity appears to be involved in the pathogenesis of osteoarthrosis, since excess weight over the years results in chronic mechanical stress for weight-bearing joints.[7]

The relation between weight and osteoporosis deserves special attention. Weight loss and low BMI constitute risk factors for osteoporosis and femur fracture.[7] However, the hypothetical benefit of obesity upon the osteoporosis risk is questionable.[21] Observational studies have shown a positive correlation between obesity and bone mineral density (BMD). It was presumed that a BMD increase could be attributed both to mechanical overload determined by overweight and to hormonal factors (estrogen, insulin, leptin), which stimulate bone formation and inhibit bone reabsorption. Moreover, both BMD increase and excessive fat padding around the trochanter protect patients against femoral neck fractures in case of falls. Current evidence does not support such protective relation between obesity and decreased risk of osteoporosis and fragility fractures.[22]

ARE THERE BENEFITS ASSOCIATED WITH OBESITY IN THE ELDERLY?

The harmful effects of excess weight for the individual and for society are very well exposed in the media, which plays an important role in educating the population about the disease. There are, therefore, a large number of guidelines and interventions aimed at weight loss, not always support by strong enough scientific evidence. Any recommendation for weight reduction in the elderly, similarly to numerous other interventions, must follow the basic principle of geriatrics, in that it should only be decided after multidimensional assessment of the elderly patient and following the scientific evidence relative to this age group.

Several studies have shown that overweight in elderly patients is not associated with increased mortality. In elderly patients with heart failure, overweight and obesity are associated with a decrease in mortality when compared to those with normal weight. Patients whose weight equals or is less than the lower limit for normality have increased overall mortality. However, although many studies show higher survival in obese patients with heart failure, quality of life may be compromised by obesity. Similar results were obtained in analyzes of mortality in obese and overweight elderly patients with CAD, when compared to a group with normal weight.[6]

Therefore, before recommending weight loss for an elderly patient, the question must be asked: can the dangers of excess weight observed in younger adults be extrapolated to the elderly?

The answer is NO! To the surprise of many, overweight reduces mortality from all causes in the elderly.[13,23-27] This reduced mortality observed in the elderly creates a paradox because it goes against the evidence in younger adults. A more thorough analysis is necessary to understand this dilemma.

To dispel this paradox we need to clarify which excess weight range presented with this reduction in mortality among the elderly. Reduced mortality in elders was only observed in the overweight range (BMI 25 to 29.9, as defined by the World Health Organization). A prospective study involving 527,265 Americans aged between 50 and 71 years developed by the National Institute of Heath established that the mortality curve by body mass index (BMI) was U-shaped, i.e., that mortality was higher in the extremities (BMI<18.5 or BMI≥40). It is also worth highlighting that groups with a BMI of 25 to 26.4 and 26.5 to 27.9 were at a lower relative risk than the reference group (BMI=23.5 to 24.9).[13]

A different study assessing data from another cohort of Americans - the National Health and Nutrition Examination Survey (NHANES)[27] at three different moments (NHANES I 1971-1975, NHANES II 1976-1980 with follow ups until 1992 and NHANES III 1988-1994 with follow ups until 2000) aimed at calculating the excessive number of sudden deaths attributed to disorders associated with weight changes demonstrated similar results. Patients with BMI between 25 and 30 were not associated with increased mortality in any of the three moments.

This study, unlike the previous one, included patients aged over 70. When estimating the excess deaths attributed to changes in weight based on the relative risk found in the analyzes, it was found that 75% of the excess deaths associated with obesity (BMI>30) in the USA in the year 2000 happened in people under 70 years old. Conversely, 79% of excess deaths associated with underweight (BMI<18.5) occurred in patients aged 70 years or older.[22] This beneficial effect of excess weight in the elderly was observed even in studies that analyzed body fat distribution.[26]

It is important to highlight, moreover, that the continuation of the NHANES cohort study sought to analyze excess of deaths from a specific cause, demonstrating that the association between mortality and BMI varies according to disease.[27] This work divided the mortality analysis into three groups (cardiovascular, cancer, and non-cardiovascular and non-cancer), further subdividing it into specific causes. Among the several results, we would highlight that low birth weight was associated with increased mortality in all age groups, mainly in the non-cardiovascular non-cancer group. This result contradicts previous thinking that speculates that the increased mortality in patients with low weight is due to cardiovascular or neoplastic diseases. Conversely, mortality in the overweight group was only higher among patients with diabetes mellitus and kidney disease, being lower for other non-cardiovascular non-cancer causes and showing neutral results in the cancer and cardiovascular disease groups.

Overweight persisted as a protective factor even after the following confusing factors were excluded: smoking, fat distribution, and different causes of mortality. Another point that needs to be ascertained is fitness degree (aerobic capacity), for it may be a possible explanation for the obesity paradox. This was the goal of a Chinese study with 4,000 patients over 65 years of age that assessed BMI, abdominal circumference, hip circumference, body composition measured by dual X-ray absorptiometry (DEXA) and walking speed needed to cover 6 meters. Gait speed was used as an indicator of respiratory capacity in the elderly after a pilot-study revealed good correlation adjusted for age between walking speed and MAX VO_2 assessed by cardiopulmonary exercise testing.[28] The results of this study do not confirm the statement that physical fitness is the explanation for the obesity paradox.

In this study, it was observed that individuals with the lowest proportions of fatty tissue had the highest rates of mortality, regardless of physical conditioning. This fact draws attention to the risk of encouraging weight loss, particularly in the population over 70 years, aiming at targets typical for younger adults.

Flegal *et al.*[29], in a systematic literature review showed that obesity class 2 (BMI between 35 and 40) and class 3 (BMI>40) were associated with significantly increase in mortality from all causes. Obesity class I (BMI between 30 and 35) was not associated with increased mortality. In turn, overweight was associated with significant reduction in mortality from all causes.

Despite the importance of mortality data, we cannot forget that disability compression has an important role in the quality of life of elders. Some studies estimate that the years lost to disability due to obesity and excess weight range from six to eight years. [30-32] Research with 8,359 Americans from five centers of the Established Populations for Epidemiologic Studies of the Elderly who are independent and suffer from no disabilities presented an interesting analysis on the topic after detecting the emergence of disability during the follow-up period of seven years. Initial BMI equal to 24 was associated with low risk of disability, but extreme BMI values (< 18.5 or ≥ 30) showed higher risks of developing disabilities. By analyzing the two variables (disability and death), disability-free life expectancy was higher in subjects with a BMI between 25 and 30.[32] A study performed in Rotterdam with 5,980 patients aged 55 or older also assessed this question. The Dutch study found that weight gain is associated with high incidence and persistence of disability in activities of daily living, as well as more years lost to disability.[30]

Given the aforementioned plus the real benefit of weight loss in controlling hypertension, type 2 diabetes *mellitus*, dyslipidemia, osteoarthritis and peripheral vascular disease, recommending weight loss for the elderly is not a simple matter. Unintentional weight loss in the elderly should not be taken for granted, even among those who are above “normal” weight. Overweight associated with metabolic disorders or difficult to control symptoms suggests the need for a weight loss program. The goal of any weight loss program must be to achieve modest losses, resulting in improvement in health conditions related to overweight. This effect is very clear in patients with knee osteoarthritis.[33] It is also worth noting that older adults undergoing a weight loss program show bone and muscle mass loss in the same proportions as younger adults. However, since they begin the program with proportionally reduced levels of these tissues, excessive loss of muscle and bone mass may increase the risk of fracture or sarcopenia. Weight loss programs should be avoided or interrupted in cases of high risk of unintentional weight loss (in the presence of infections, hospitalizations, etc.). The risks of a weight reduction program are even higher for fragile patients.[34]

The importance of fully assessing the nutritional status as part of the multidimensional evaluation of elders must be stressed. We also conclude that excess weight can be beneficial for the elderly. Recognizing and controlling comorbidities directly related to overweight must be a priority, as well as avoiding involuntary weight loss or gain in the elderly.

REFERENCES

1. Li Z, Heber D. Sarcopenic obesity in the elderly and strategies for weight management. Nutr Rev. 2012, Jan; 70(1):57-64.
2. St-Onge MP. Relationship between body composition changes and changes in physical function and metabolic risk factors in aging. Curr Opin Clin Nutr Metab Care. 2005 Sep; 8(5):523-8.
3. Cree MG, Newcomer BR, Katsanos CS, Sheffield-Moore M, Chinkes D, Aarsland A, et al. Intramuscular and liver triglycerides are increased in the elderly. J Clin Endocrinol Metab. 2004, Aug; 89(8):3864-71.
4. Tchernof A, Després JP. Pathophysiology of human visceral obesity: An update. Physiol Rev. 2013 Jan; 93(1):359-404.
5. Mathus-Vliegen EM. Obesity and the elderly. J Clin Gastroenterol. 2012, Aug; 46(7):533-44.
6. Dorner TE, Rieder A. Obesity paradox in elderly patients with cardiovascular diseases. Int J Cardiol. 2012, Feb 23; 155(1):56-65.
7. Villareal DT, Apovian CM, Kushner RF, Klein S, NAASO. The Obesity Society. Obesity in older adults: Technical review and position statement of the american society for nutrition and NAASO, the obesity society. Am J Clin Nutr. 2005, Nov; 82(5):923-34.
8. Böhm A, Heitmann BL. The use of bioelectrical impedance analysis for body composition in epidemiological studies. Eur J Clin Nutr. 2013, Jan; 67(Suppl 1):S79-85.
9. Moraes END. Princípios básicos de geriatria e gerontologia. Belo Horizonte: Coopmed; 2008.
10. Ritz P. Validity of measuring knee-height as an estimate of height in diseased french elderly persons. J Nutr Health Aging. 2004; 8:386-8.
11. Lipschitz DA. Screening for nutritional status in the elderly. Prim Care. 1994 Mar; 21(1):55-67.
12. Cervi A, Franceschini SDCC, Priore SE. Análisecrítica do uso do índice de massa corporal paraidosos; critical analysis of the use of the body mass index for the elderly. Rev Nutr. 2005; 18(6):765-75.
13. Adams KF, Schatzkin A, Harris TB, Kipnis V, Mouw T, Ballard-Barbash R, et al. Overweight, obesity, and mortality in a large prospective cohort of persons 50 to 71 years old. N Engl J Med. 2006 Aug 24; 355(8):763-78.
14. Poirier P, Giles TD, Bray GA, Hong Y, Stern JS, Pi-Sunyer FX, et al. Obesity and cardiovascular disease: Pathophysiology, evaluation, and effect of weight loss: An update of the 1997 American Heart Association Scientific Statement on Obesity and Heart Disease from the obesity committee of the council on nutrition, physical activity, and metabolism. Circulation. 2006 Feb 14; 113(6):898-918.
15. Stephen WC, Janssen I. Sarcopenic-obesity and cardiovascular disease risk in the elderly. J Nutr Health Aging. 2009 May; 13(5):460-6.
16. Folsom AR, Kushi LH, Anderson KE, Mink PJ, Olson JE, Hong CP, et al. Associations of general and abdominal obesity with multiple health outcomes in older women: The iowa women's health study. Arch Intern Med. 2000 July 24; 160(14):2117-28.
17. Iwao S, Iwao N, Muller DC, Elahi D, Shimokata H, Andres R. Effect of aging on the relationship between multiple risk factors and waist circumference. J Am Geriatr Soc. 2000, July; 48(7):788-94.
18. Park YW, Zhu S, Palaniappan L, Heshka S, Carnethon MR, Heymsfield SB. The metabolic syndrome: Prevalence and associated risk factor findings in the US population from the third national health and nutrition examination survey, 1988-1994. Arch Intern Med. 2003 Feb 24; 163(4):427-36.
19. Imbeault P, Prins JB, Stolic M, Russell AW, O'Moore-Sullivan T, Després JP, et al. Aging per se does not influence glucose homeostasis: In vivo and in vitro evidence. Diabetes Care. 2003 Feb; 26(2):480-4.
20. Joseph LJ, Ryan AS, Sorkin J, Mangano C, Brendle DC, Corretti MC, et al. Body fat distribution and flow-mediated endothelium--dependent vasodilation in older men. Int J Obes. 2002 May; 26(5):663-9.
21. Zhao LJ, Jiang H, Papasian CJ, Maulik D, Drees B, Hamilton J, Deng HW. Correlation of obesity and osteoporosis: Effect of fat mass on the determination of osteoporosis. J Bone Miner Res. 2008 Jan; 23(1):17-29.
22. Zhang X, Sun Z, Zhang X, Zheng L, Liu S, Xu C, et al. Prevalence and associated factors of overweight and obesity in a chinese rural population. Obesity. 2008 Jan; 16(1):168-71.
23. Diehr P, Bild DE, Harris TB, Duxbury A, Siscovick D, Rossi M. Body mass index and mortality in nonsmoking older adults: The cardiovascular health study. Am J Public Health 1998 Apr; 88(4):623-9.
24. Freedman DM, Ron E, Ballard-Barbash R, Doody MM, Linet MS. Body mass index and all-cause mortality in a nationwide US cohort. Int J Obes. 2006 May; 30(5):822-9.
25. Auyeung TW, Lee JS, Leung J, Kwok T, Leung PC, Woo J. Survival in older men may benefit from being slightly overweight and centrally obese–a 5-year follow-up study in 4,000 older adults using DXA. J Gerontol A BiolSci Med Sci. 2010 Jan; 65(1):99-104.

26. Reis JP, Macera CA, Araneta MR, Lindsay SP, Marshall SJ, Wingard DL. Comparison of overall obesity and body fat distribution in predicting risk of mortality. Obesity. 2009 June; 17(6):1232-9.

27. Flegal KM, Graubard BI, Williamson DF, Gail MH. Excess deaths associated with underweight, overweight, and obesity. JAMA. 2005 Apr 20; 293(15):1861-7.

28. Woo J, Yu R, Yau F. Fitness, fatness and survival in elderly populations. Age (Dordr). 2013 Jun; 35(3):973-84

29. Flegal KM, Kit BK, Orpana H, Graubard BI. Association of all-cause mortality with overweight and obesity using standard body mass index categories: A systematic review and meta-analysis. JAMA 2013 Jan 2; 309(1):71-82.

30. Walter S, Kunst A, Mackenbach J, Hofman A, Tiemeier H. Mortality and disability: The effect of overweight and obesity. Int J Obes. 2009 Dec; 33(12):1410-8.

31. Arterburn DE, McDonell MB, Hedrick SC, Diehr P, Fihn SD. Association of body weight with condition-specific quality of life in male veterans. Am J Med. 2004 Nov 15; 117(10):738-46.

32. Al Snih S, Ottenbacher KJ, Markides KS, Kuo YF, Eschbach K, Goodwin JS. The effect of obesity on disability vs mortality in older americans. Arch Intern Med. 2007 Apr 23;167(8):774-80.

33. Miller GD, Nicklas BJ, Davis C, Loeser RF, Lenchik L, Messier SP. Intensive weight loss program improves physical function in older obese adults with knee osteoarthritis. Obesity. 2006; 14(7):1219-30.

34. Hazzard WR, Halter JB. Hazzard's geriatric medicine and gerontology. 6 illust ed. New York: McGraw-Hill Education; 2008.