Functional assessment of the elderly

VI CHAPTER

FUNCTIONAL ASSESSMENT OF THE ELDERLY

Claudio Macchi

VI.1 The functional characteristics of the Elderly

The first evaluation to be done is the calculation of body mass index (BMI) also known as BMI (Body Mass Index) which can be calculated with the following formula: weight in Kg/ height 2 in meters (for example, an individual of 70 kg and high 75 m, the BMI will be 70 / (1.75 x 1.75) = 22.87. The normal values are between 18.5 and 24; values below 18.5 indicate leanness, which is serious for values below 17.

The weight control is one of the main reasons for an adult, especially women, starts a physical activity. For the elderly it is different, since in most cases, physical activity is seen as a *labour* and it is very hard to convince him/her that it can be considered as a more effective therapy than pharmacology, especially with a preventive purpose.

Table I.VI summarizes the health risks related to BMI. On the contrary, as regards as the body composition, we must consider the following:

- **body mass** (BM) is defined by the formula: BM = fat mass (primary fat and fat storage) + lean mass.

- **fat free mass** (FFM) is defined as: FFM = fat free mass and primary fat (CNS; viscera = 4-7% BM).

-**fat mass** (FM) is the fat storage.

It is important to remember that the BMI does not take into account the amount of muscle or fat of the individual. The physically fit person with a large muscle mass may in fact be classified as obese, and overweight is because he/she has muscle than fat body.

Researchers agree that fat body is a better indicator of health status. To help in alleviating this problem it can be useful to measure waist circumference, which gives an indication of abdominal fat and is closely linked to the presence of various diseases such as type 2 diabetes, hypertension and coronary heart disease.

Numerous clinical studies have suggested that abdominal adiposity assessment, by measurement of waist or waist-hip ratio, can dramatically improve more the prediction of the risk of cardiovascular disease than the assessment based solely on total fat mass, estimated from the calculation of BMI[14]. The guidelines recommend close monitoring of the abdominal circumference in subjects with a BMI between 25 and 34.9 by defining abdominal obesity in subjects that found values of waist circumference greater than 102 cm in men and 88 cm in women, and greater than 1.0 and 0.85 respectively for the waist-to- hip ratio [2]

The role of BMI as a marker of risk of death and desease[3] has been under discussion for several years.

A study published in JAMA, based on data from the National Health and Nutrition Examination Survey (NHANES) [5] analyzed the correlation between BMI and mortality

from all causes by showing that the BMI is not a good predictor of mortality for any reason. Up to 69 years of age, in fact, only a BMI greater than 35 is associated to an increased risk of death (approximately 2-times); above the age of 65, however, the increased risk is associated only to underweight, and even serious obesity is considered irrelevant.

Likewise, a meta-analysis published in Lancet in 2006 [6] on about 250 000 individuals in 40 epidemiological studies for a medium follow-up of 3.8 years has confirmed that mortality from all causes did not increase among subjects classified as overweight "according to BMI, but it is significantly higher among subjects with a less than advisable BMI; in that both obese subjects and those underweight (always based on BMI) had a significant excess of mortality due to cardiovascular disease. Another study [7] found a limited increase in risk of death among around 50 years old people with high BMI.

Studies on the association between general and abdominal adiposity and the risk of death from any cause, however, suggest that abdominal adiposity may be an important predictor of risk.

The available data on the association between waist circumference or waist-hip ratio and risk of death are still limited. A study [8] that focuses on the European population, provides important information about the relationships between general obesity, abdominal adiposity and the risk of death[8].

This study examined the association between BMI and waist circumference, waist-hip ratio and risk of death in 359,387 subjects from nine European countries followed for a medium follow-up of 9.7 years, as part of the EPIC study (European Prospective Investigation into Cancer and Nutrition). The causes of death were classified as cardiovascular, cancer, respiratory or other. The entire cohort was divided into nine categories of BMI. These categories incorporate the existing definitions of underweight (<18.5), normal weight (18.5 to 25), overweight (25-30) and obesity (≥ 35). The subjects as well were divided into quintiles according to the measured values of waist and waist-o hip ratio, stratified by age and sex.

The adjustment of statistical data covered the smoking, educational level, alcohol consumption, physical activity and stature. The study showed that BMI is associated with the risk of death from any cause in a non-linear way. The lower risk is associated to a 24.3 BMI for men and 25.3 BMI for women, while with both lower and higher BMI values the risk is higher and follows the "J" curve, consistent with the results of previous studies 7. When waist circumference and waist-hip ratio are independently assessed, they are associated with the risk of death with the same trend, but after statistical adjustment for BMI, both waist circumference and the waist-hip ratio have a strong positive association with the risk of death.

The risks of the subjects in the highest quintile of waist circumference and waist-hip ratio were in fact equal, respectively, to 2.05 for men and 1.78 for women, and again to 1.68 for men and 1.51 for women. It was possible to estimate that, for a given BMI, the increase of 5 cm of waist circumference or 0.1 waist-hip ratio corresponds to a significantly increased risk in men (1.17 and 1.13) both in women (1.34 and 1.24).

By dividing the participants into three groups of BMI (<24.9 - 24.9 to 27.7 -> 27.7), it is shown that the actors within the lower range of BMI (<24.9) located in the quintile high waist circumference (≥ 102.7) and with a waist-hip ratio (≥ 0.99) show the highest relative risk of death compared to the group of reference (consisting of persons belonging to the second level of BMI and the lowest quintile of both parameters).

Even those classified as persons with a normal weight (BMI 18.5 to 25) but belonging to the highest quintile of waist and waist-hip ratio have a relative high risk of death (2.06 for men and 1.79 women) compared to the lower quintile.

In conclusion, the study demonstrates that general and abdominal adiposity are associated, even in an independent manner, to the risk of death and supports the use of waist circumference and waist-hip ratio in addition to BMI in assessing the risk of death.

Analysis of data shows the importance of assessing the distribution of body fat in relation to the cutoff points for defining abdominal adiposity in order to predict the risk of death even in normal weight subjects.

Table I.VI

BMI	RISKS FOR THE HEALTH
< 17	SERIOUS THINNESS . All the secondary diseases linked to macro and micro undernourishment can be included into this condition. It is associated to reduction of the muscular mass, of the plasmatic proteins, loss of the bony mass with consequent increase of fractures, weakening of the immune system, insufficient regeneration of the damaged tissues.
17-18,4	MODERATE THINNESS. There might always be health problems linked to undernourishment.
18,5-19.9	UNDERWEIGHT. There is a minimum risk to get cardiovascular diseases.
20-24,9	NORMAL. An IMC equal to 25 corresponds to the limit over which it is possible to get diseases due to the weight. Over this limit, the causes ascribed to the disease are gradually increasing. It may be useful to check the diet.
25-29,9	OVERWEIGHT. The risk of cardiovascular diseases increase as well as no-insulin dependent diabetes, brain ictus, hypertension and secondary arthrosis.
30-34,9	MODERATEOVERWEIGHT. High risk of cardiovascular diseases, no-insulin dependent diabetes, hypertension and some types of cancer. It is often necessary to start cures combined with a diet and sport practice.
35-39,9	SERIUOUS OVERWEIGHT.It is always linked to one or more of the above said diseases with a negative effect on the health and life.
oltre 40	HIGH OVERWEIGHT. There are one or more of the abovementioneddiseases and appropriate cures are neededafter a carefulhealthcheck.

According to the guidelines of ACSM [9, 10,] because the physical activity affects BM and FM it is required an energy expenditure of 250-300 kcal per session, with a frequency of 3 sessions per week.

Alternatively, sessions at a cost of 200 kcal energy 4 times a week are recommended.

Under the type of exercise is recommended any mode of pretty intense aerobic exercise14 for a period of 30-35 or longer moderate intensity sessions [11]. The walk only is not effective, but it can increase energy expenditure walking with weights at the ankles or wrists or walking longer (eg.60').

The training of strength [12,14] which produces an equivalent energy expenditure increases FFM more than it decreases the FM; to increase the muscle mass required in some athletic competitions it is required to associate with AF an low calorie diet: the addition of 700 - 1000 kcal / day is sufficient for the synthesis of 0.5-1 kg FFM / week [13, 14].

Dealing with overweight generally requires modification of other lifestyle habits, especially diet, in addition to the regular practice of a physical activity, and this must always be remembered for users, not to create false expectations. The treatment of obesity (BMI> 30) is a complex problem and requires medical supervision.

It is necessary to create an energy deficit (it is prudent not to exceed than 500-1000 kcal / day) to lose weight, which can be produced in isolation by increasing the expenditure with a program of physical activity or reducing the intake with a diet or combining these two approaches.

Regular physical activity shifts the threshold of satiety to the hypothalamus, reducing appetite. Exercise also increases your basal metabolism, lipid catabolism and protein synthesis. However, it is very difficult to lose weight only through physical activity. According to the ACSM, the recommended training (AA 250-300 kcal. 3 sessions per week, or 200 kcal 4 sessions per week) reduces BM and FM, maintaining FFM the same or increasing slightly. The "localized" loss of adipose tissue by the activation of muscle groups corresponding to the target areas has never been proven effective.

The obese should start very slowly, even with lower intensity than recommended or with intermittent but regular training. In these subjects will be sufficient as a first step to suggest short walks as the antigravitary work directly proportional to body weight for obese has a greater commitment than the lean and normal weight subjects. Caloric restriction in the diet is effective but it needs to be more rigid if not associated with physical activity. The weight loss in the first days of the diet depends on the loss of water and the depletion of glycogen stores, the breakdown of fats begins after a few days of diet and percentage increases with the time: it is therefore important to persist over the time!

The more a diet is rigid the more it induces hunger and psychological stress, it is common practice to recommend to combine the two approaches. Furthermore, the reduction of BM with diet alone also leads to a reduction in FFM for the induction of protein catabolism, counteracted by regular physical activity.

Physical activity also counteracts with other negative effects of diet alone, such as the increasing of the threshold for satiety, lipoprotein lipase activity, reduced basal metabolic rate.

In the hypocaloric diet associated with AA markedly decreases BM, FM and FFM; however, FFM decreases less than diet alone.

In conclusion, the combination of the two approaches allows more tolerable regimes of diet and exercise over time and significantly enhances the process of weight loss. This is achieved by reducing the cell volume of adipocytes, rather than their overall number. In fact it is the first parameter that changes with the energy balance, while the second (number) seems to increase only in severe obesity. For reasons not fully understood, but in relation to the different distribution of fat in both sexes, the man tends to mobilize abdominal fat, the woman has a greater deposition of fat in the buttocks, which is metabolized in a more difficult way.

There are differences of morphological and physiological relevance for the fitness and performance between men and women; however the differences in athletic performance in the two sexes are largely due to their different size and body composition [14].

Current data show that:

- women have lower FFM and BM, higher FM and decreased bone density than men;
- women have a reduced capacity of the three energy systems;
- the correct difference in VO2 max for FFM is almost canceled;
- the increase in VO2 max, with AA is the same in the two sexes;
- the increase in VO2 max, with AA is not affected by the menstrual cycle;
- the absolute strength is the 2 / 3 of that of men, the power is still smaller than that expressed by males of the same age;
- the increase in muscle strength with AF is equal to man, but the muscle hypertrophy is less (this depends on the testosterone).

About the risk of injury, women are more exposed to those muscle-skeletal in high-impact activities involving the lower limbs, for the reduced muscle mass and the marked Q angle at the knee. The angle Q, formed by the axis of the femur and the tibia, has a physiological valgus of a few degrees: they increase the valgus, increase the stress on the patella and the medial collateral ligament and therefore the risk of injury at that level. Also in contact sports there is a risk of injury to the breast.

VI.2 Selecting the capabilities to be developed in the elderly

Over the past 50 years coaches, athletic trainers, sports doctors and anthropologists have been very interested in understanding anthropometric characteristics that allow for maximum performance in sports, but very little in clarifying those characteristics that allow for health maintenance among the elderly.

The prescription of a physical activity program in the elderly must consider the influence of the following factors:

- the response of elderly body to training and exercise;
- the "law of inversion activity levels", i.e. physical activity progressively decreases with advancing age, while the energy cost of a given activity progressively increases;
- beliefs and attitudes about the health of the elderly;
- The influence of medical, personal, occupational and physical factors.

In the elderly, it is also crucial to work on two fundamental elements that can often be compromised by the aging process and that significantly increase the risk of injury and falls: balance and neuro-motor coordination (15). Balance is a complex function involving the vestibule, the sight, external and proprioceptive sensibility, strength, flexibility and neuromotor coordination. This last is essential for the economy of

movement: movements involving different body segments in opposition, or movements in which a body segment crosses the median line, are more difficult, especially in the elderly. The training of balance is present in many Oriental disciplines, like yoga and tai chi, and should be part of any training program in the elderly.

For the healthy elderly who have as their target the achievement and maintenance of their physical fitness, we report the ACSM recommendations for the optimal characteristics of an exercise program designed to achieve and maintain fitness for healthy adults with some adjustments for the elderly:

- sedentary older people should start with short sessions of moderate-intensity activity (5-10 minutes) and gradually increase the duration;
- the maximum intensity should never be reached, not even in trained subjects;
- high-impact and the very rapid exercises (e.g. jumping) must be avoided;
- with regard to joint mobility, it is recommended to start with stretching for 3-8 sec up to 15-60 sec for each movement; start from 5 to 15 min per session;
- the increase of workload and technical engagement over time must to be more gradual with advancing age: the physiological adaptations in the elderly are, in fact, slower than in adults;
- in the elderly it is essential to remember that the response to exercise, and therefore the rate of progression, should be individualized;
- reversibility is more rapid in the elderly: it begins within a few days to be completed in 3-8 weeks.

In the first part, we have shown that aerobic training and muscle strengthening have different indications and effects, which only partially overlap.

Schematically, we remember the documented effects and the most common indications for the two types of training.

- In older persons, compared to younger subjects, aerobic exercise produces a greater increase of VO_2max and of the effect of insulin, and a greater improvement of muscle oxidative capacity; it does not increase the maximal cardiac power and there is no attenuation of the response to exercise. Aerobic exercise is recommended for the prevention and treatment of diabetes, hypertension, obesity, osteoporosis and arthritis.
- Strength training increases muscle mass, strength and power, but also increases the mechanical resistance of bones and the VO_2max (though less than aerobic exercise); it also improves glucose tolerance; it should preferentially affect the muscle groups involved in activities of daily living, especially those of the lower limbs; strength training is recommended in sarcopenia (the loss of muscle mass that occurs with aging) and for the prevention and treatment of osteoporosis.

Joint mobility should be trained to counteract the effects of aging and sedentary lifestyle on the loss of flexibility. Active mobility is enhanced by exercising major joints, according to the principles described in the warm-up section. Stretching should be static; stability and and how to stretch the various muscle groups should be considered first; the duration starts from 5 sec for few muscle groups and should be increased gradually, always under the threshold of pain, progressively involving other muscle groups.

Suggested activities vary depending on functional level, health and fitness, and also on motivation, psychological characteristics and practical constraints (travel, financial resources) of subjects, along with their previous history. The fundamental principle

remains that the practice of physical activity will be maintained over time only if it appears as something enjoyable and rewarding.

In addition to traditional group exercise programs (“exercise for the elderly "), it is possible to perform in the gym circuit training programs or music programs; dancing is also a good exercise and it is often appreciated by older people more than by adults. Even low-impact aerobic activities in the pool (swimming, water gym) or outdoors (walking, cycling and running, in some cases) might be activities that can be proposed and carried out safely, with documented positive impact on fitness and health of the elderly.

VI.3 Physical activity, aging and disability

Older population includes not only healthy individuals, but also people with one or more non-disabling diseases or diseases that produce a disability that may be mild, moderate or severe. It is very common in Geriatrics to face subjects in whom the loss of function is related to several factors.

On one hand, we have cardiovascular, respiratory and metabolic conditions that may contraindicate certain types of exercise. On the other, we have musculoskeletal diseases, such as arthritis, osteoporosis, foot deformity, which often join together to produce a complex motor disability; finally we have to remember the loss of muscle mass not related to intrinsic muscle diseases, but to chronic neurological diseases (Parkinson, subcortical encephalopathy).

Many older subjects with multiple diseases show pictures of this kind, however, this does not mean that exercise must necessarily be “medicalized” and identified with rehabilitation. Over the last decade effective exercise plans have been designed for elderly people suffering from multiple diseases, but relatively free of cardiovascular risk. These programs may, after a careful assessment of the patient, be carried out in gyms or even at home, with the supervision of non-medical personnel. It is not always possible, in these programs, to achieve work intensity and volume such to produce the necessary adjustments to achieve and maintain fitness, according to ACSM recommendations; however, based upon the “exercise dose continuum” principle, these activities are recommended and useful for health, since they act on the prevention and treatment of many diseases, on socialization and on many other aspects of quality of life

Surgeon General Report (17) recommendations on Physical Activity and Health have established that people of all ages benefit from physical activity and that significant health benefits can be achieved with a moderate amount of physical activity equivalent to a caloric expenditure of 150 kcal per day or 1000 kcal per week, as 30 min fast walk, dance or Aquagym, or about 20 min swimming, but also a 45 min pushing their wheelchair on flat ground, if carried out every day or most days a week.

These recommendations also include a specific section for the elderly, which states that "the elderly can benefit from a moderate amount of physical activity preferably on a daily basis, made in the form of lighter activities held for longer time, or in the form of more challenging tasks (such as brisk walking or climbing stairs) held for shorter time”: it is also stated that greater amounts of physical activity intensity, frequency and / or duration may provide additional benefits, but also involve greater risk of injury, so that any increase should be very gradual. It is also recommended that a

sedentary elderly who wants to undertake a program of physical activity should first address to the doctor and start with 5-10 minutes of daily activities and gradually increase the duration of activities; finally, it is recommended to always combine aerobic activity with a component of strength training.

Indeed, according to the "exercise dose continuum" principle, reaffirmed by the ACSM (9, 10) also carrying a minimum of physical activity is better for health, compared with an absolute lack of exercise; so the 1996 recommendations are slightly changed: now it is claimed that at least 30 'of light physical activity, also subdivided within the day, for most days a week, are sufficient to produce significant health benefits. These statements are important because the recommended goal can be reached by persons already sick and disabled. Even in the elderly with disabilities, limited amounts of physical activity are useful and recommended for the promotion of health, if the activities are appropriate to the functional level and made in safety; in this regard, supervised exercises are generally recommended; if arranging the continued participation of older disabled in these exercise classes is difficult, it might be possible, in the case of available family members or other caregivers, to educate these individuals to oversee the elderly during the exercises at home, providing security and, to some extent, evaluating also the proper performance. A protocol for group treatment, defined as motor reactivation, was developed and successfully practiced in the Authors' center (18). This program, specifically tailored for geriatric patients suffering from chronic musculoskeletal disorders and initial motor disability, which meets the literature requirements for an exercise program for the elderly, includes tips on ergonomics, flexibility exercises, muscle strengthening (particularly for lower limbs), balance and coordination that the patient learns under the supervision of the therapist and then continues at home.

Several sports clubs offer physical activity programs in nursing homes or day centers, working with people with moderate to severe disabilities. These programs are effective in preventing disability and promoting the maintenance or the improvement of the functional level. This does not question the need for rehabilitation performed by qualified personnel that includes passive and active treatment for severely disabled patients, such as post-acute (fracture, surgery) and chronic severe disabilities. For older people with mild to moderate disabilities it is often difficult to determine who can be safely directed to exercise programs at home or to supervised activities in the territory (which combine the specific advantages with those related to socialization and improvement of self-image), and who, on the contrary, needs a more strictly rehabilitative approach. Among the many factors to be considered, the presence of serious comorbid cardiovascular or respiratory conditions that also require supervision in performing minimal exercises should be included; even in those cases where there is a sharp pain, regardless of the severity of the underlying disease, either mechanical or inflammatory rest and physical or manual therapy, or targeted drug medication, are needed before starting an exercise program. Apart from these contraindications, it can be argued that, if followed by operators with specific training, the practice of regular physical activity targeted is useful and desirable for all older people.