Methods and Didactics of Motor Activities in the Elderly

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INTRODUCTION

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Over the next 30 years the number of older persons will gradually increase in most countries, along with disabilities, and more attention will be paid to the improvement of quality of life rather than to the increase of life expectancy.

Although aging is an unavoidable process, many diseases and disabilities can be prevented, or at least delayed, through appropriate physical activity programs.

The boundary between the disabilities caused by disease and those associated with functional limitations, often related to incorrect habits and lifestyles, is uncertain. Furthermore, it is also uncertain whether different life expectancy and risk of death depend on environmental differences or on differences in physical activity related to the environment.

Paffenbarger's [1] studies have shown that individuals physically active have a longer life expectancy than sedentary persons. Specifically, the study conducted on 17,000 alumni of the Harvard University [1] has demonstrated that individuals more physically active showed a statistically significant reduction in the relative risk of death from all causes and from cardiovascular diseases and that the magnitude of the effect was directly related to the amount of physical activity. The same study also showed that people who had begun to practice regular physical activity in adulthood or in more advanced age showed the same mortality rate as those who had been active all life long, and that, on the contrary, active individuals who had become sedentary with advancing age showed the same risk of death as those who had been sedentary all life long.

We can therefore say that there are many confirmations of the beneficial effects of an active lifestyle and a moderate physical activity and that good physical fitness has positive effects on longevity as much as a regular physical activity on risk of mortality (particularly from respiratory and vascular causes). However, we should also consider that often those who practice regular physical activity lead healthier lifestyles, get sick less often, rarely smoke, follow a balanced diet, avoid weight gain, and pay more attention to medical controls and disease prevention. This, obviously, might bias the results of some scientific studies: however, the correction for potential confounders often improves the reliability of study results.

We can easily understand why aging “per se” substantially contributes to the increase of medical and social costs. In fact, the fragmentation of families and the economic globalization have led to an excessive institutionalization of older persons and to an abnormal proliferation of nursing homes. As a consequence, older persons experience loneliness, depression, along with reduction of physical activity, disability and renunciation of life.

CHAPTER I

AGING AND PHYSICAL ACTIVITY

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I.1 Aging and lifestyles

On average, all of us risk to spend about 15% of the duration of our life in a state of disease, with a longer period of disability for women, both because they live longer and because women show a higher prevalence and a higher survival rate in case of chronic diseases.

Previous papers have shown a functional identity between the character of a person and his/her body attitude. Often chronic muscle tension, joint limitations and many other physical changes occur during childhood and then progress throughout adulthood and old age.

Psychology has always preferred everything is evolving, such as childhood and adolescence, but in recent years it has begun to take an interest to adults and older adults.

Demographic data show, in fact, the increase of life expectancy in the population, which already has, and will have in the future, a major impact on both economy of nations and their social organization.

Psychological aspects and intellectual capabilities undergo involution when creativity and operational gestures are less successful than in previous ages, with rare exceptions, even if these last cases show, anyhow, a clear slowdown of intellectual activity, reduced memory, attention and adaptation to any kind of change.

With aging, changes in the emotional sphere are sometimes more pronounced than those in the intellectual sphere. The separation from children, the loss of spouse and the gradual disappearance of relatives and friends, make the elderly more and more alone, less autonomous and dependent on others, even for ordinary acts of everyday life, hence the fear of isolation and depression take place.

One of the most serious social aspects of aging is the changed relationship with sons and daughters. The elderly are often more tolerated than desired, especially when they live together and are no longer able to look after grandchildren or perform housework, though almost always they substantially contribute to the family income with their pension.

With retirement there are radical changes in older persons' lifestyle, to which they are never prepared enough, though often, at least initially, the retirement is considered a well-deserved rest period similar to vacations or holidays. After a pleasant period, which may last more or less long, the discomfort associated with the loss of work and temporal-spatial references, upon which their previous existence had been based, takes place, with depressive or aggressive reactions.

From these brief considerations it is apparent that for every age it is important to preserve its own health and physical shape to protect independence and self-esteem,

which are essential for a good quality of life. The teacher, instructor, personal trainer or whatever you want to call who is involved in the evaluation of the physical and mental health of the subject, in all forms of training to health promotion must be able to advice both on training and on lifestyle, even through a series of motivational stimuli of various kinds.

To do this he/she must be culturally prepared and temperamentally predisposed to human relationships, and understand the psychology characteristic of different stages of life.

I.2 Physical activity and mental health in the elderly

The concept of mental health is almost impossible to define, at least in a sufficiently unique and widely shared way. Even the World Health Organization has avoided on official definitions. It is difficult to refer to a condition called normal, because the absence of mental illness does not necessarily mean mental health, as well as for the definition of the concept of health [2]. This becomes particularly difficult in the elderly, who often suffer from co-morbidities that "per se" cause changes in mood and behavior.

The mental disease in the elderly, is often associated with low self-esteem, sleep disturbances, depressed mood, lifestyles and behaviors unfit for their health.

Undoubtedly we can say that the loss of mental health results in a state of emotional and psychological distress that often prevents the use of one's abilities within the social life and daily activities. In this condition it is difficult to participate in environmental and social changes, to establish satisfactory relations, to preserve one's personality with self-esteem and resolve conflicts [3].

The relationship between physical activity and mental state at all stages of life is widely shared. Researches in this field include the evaluation of both psychological deterrents, and incentives, for participation in the exercise (motivation) and psychological factors influencing the athletic performance. [4, 5]

The positive effects of exercise in the elderly on the psychological sphere may be indirect, through the reduction of symptoms related to weight loss, or direct, through the improvement of anxiety, depression [6] and cognitive performances [7].

The studies, mainly developed since the 70s, have consistently shown a positive effect of physical activity on psychological wellbeing. Early studies have focused on reducing negative emotions (normal and pathological anxiety, mistrust in oneself), while with time the evidence on physical activity as a promoter of positive feelings, like the sense of energy, has progressively increased. In this regard Thayer [5] showed that a 10-minute walk is more effective in reducing tension and producing a sense of energy than eating a sweet or smoking.

However, the dose-dependent correlation between exercise (frequency, intensity and duration of sessions) and emotional aspects has not yet been clarified: even a single session can produce a feeling of wellbeing lasting several hours.

Although the mechanisms by which exercise produces these effects have also not yet been clarified, the most accredited hypotheses include:
- Distraction - The exercise can distract from everyday worries. The positive effects on the psychological sphere have been demonstrated in some studies while others studies have provided no significant correlations: thus the question is still open.
- Endorphins - endorphins are endogenous opioids released into the circulation in response to various stimuli, including physical activity: some studies have shown that there is a correlation between high circulating levels of endorphins and well-being after a session of exercise, but the biochemical block of their effect in vivo, maintained the sensation of well being in some subjects. Therefore, the role of endorphins is not yet precisely defined.
- Thermogenesis - An exercise intense enough to cause an increase in body temperature, through the action of the hypothalamus and the thalamus, is able to stimulate certain brain areas, which in turn induce muscle relaxation. The hypothesis is that this relaxation, producing a reduction of sensory stimulation, has positive effects on the psychological sphere [8, 9].
- Monoamines - Neurotransmitters such as norepinephrine, dopamine and serotonin affect mood by acting on the CNS: physical activity changes intra-cerebral levels of monoamines in animals, and recent studies seem to validate these findings also in humans.
- Cerebral blood flow - a selective increase of cerebral blood flow in the cortex (frontal lobe, parietal and temporal lobes) and gray matter, in which the areas of the emotional control are localized, has been shown in some studies, and it correlated with arousal increase (supervisory level), with cognitive performance and emotional state, probably by modulating the local metabolism of monoamines.

Changes in levels of monoamines and cerebral flow are the biological mechanisms also evoked to explain the benefits of physical activity practiced regularly over time: psychological and social factors play a pivotal role.

The practice of regular physical activity increases both self-esteem (i.e. the evaluative component of self-conception) and self-efficacy (i.e. the confidence in one's ability to follow the best line of action required in different situations). Furthermore, regular physical activity seems to promote a more internal locus of control, by increasing the perception of being able to positively affect life through one's behavior, instead of feeling that life is beyond one's control and determined solely by external agents (external locus of control). These effects have been shown both in younger and in older adults, who often show a reduction of self-efficacy and a turning outside the locus of control.[10, 11] The types of activities need, however, to be further investigated: since first studies both aerobic and resistance exercises have proven to be effective in improving the mood (depression), while only aerobic exercise appears to be effective in reducing anxiety. Surely, even the effects of exercise on physical aspect, as well as on body image, on physical fitness, and in some cases, on symptoms, have a positive impact on the psychological wellbeing of active individuals. Especially in the elderly,

but not only in these, it is likely that the care received during physical activity programs and the socialization in group activities might play a pivotal role. On the contrary, as regards the effect of exercise on major psychiatric diseases (major depression, panic attacks, pathological anxiety, schizophrenia), many studies suggest a possible positive effect of some forms of physical activity in combination with targeted drug therapy, but available evidence is not conclusive.

CHAPTER II

BASIC DIDACTIC AND BIOMEDICAL KNOWLEDGES FOR TEACHING MOTOR ACTIVITIES TO THE ELDERLY

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II.1 Biomedical and didactic glossary.

In order to avoid situations where a graduated in Motor Sciences, in his/her role as a teacher, instructor, expert or interested on the subject, takes a wrong or improper terminology or, which is even worse, a terminology contaminated by flaws or false beliefs, I think it is important to clarify some aspects of terminology. This is not a rhetorical attachment to "definitions": it is just because everything originates and is characterized by starting from its proper definition. Knowledge is the basis of culture because it is based on the distinction and the more precise the distinction, the lower the risk of mistakes and confusion.

Nothing should be done as an end in itself but it should be done in order to achieve resulting actions, in all fields, especially in health.

Knowledge must also be the tool to break down barriers and overcome prejudice, cultural poverty and ignorance, which are the greatest enemies of a tolerant society, able to include rather than exclude, to regard diversity and disability as richness, instead of escaping for the fear to be contaminated, taking refuge in useless and sterile discrimination.

> **Health**: According to WHO (1948), health is "a state of complete physical, mental and social wellbeing and not merely the absence of the state of disease or infirmity". The definition of health proposed by the WHO at the International Conference on Health Promotion Ottawa (17-21 November 1986) summarizes and synthesizes these principles, adding that to achieve a state of complete physical, mental and social, individuals must be able to identify and realize their own aspirations, to satisfy their own needs and to modify or adapt to the environment; health is seen as a resource for everyday life that enhances the value of personal physical, mental and social skills and that can be reached by developing physical, mental, social and material resources.

> **Health promotion**: A process that enables individuals to increase the control over their own health and to improve it.

> **Health education**: it includes consciously constructed opportunities for learning that involve some form of communication, designed to best learn about health, to improve knowledge and to develop those life skills that contribute to individual and community health (WHO, 1998).

> **Policy for health**: "a political (national) health promotion is the common strategy based on primary objectives on which all persons and entities involved in health promotion agree - a solid ideal foundation with clearly defined priorities and competences" (Health Promotion, Switzerland, 2000).

> **Old age**: this is definition that has been fascinating the greatest experts in the field for the last 50 years. The WHO definition according to which are to be considered as elderly individuals over 65 years is actually anachronistic, but in the last 30 years at least 30 other definitions can be cited, more detailed and that consider other factors that typical and frequent ' aging, equally valid. However, particularly for epidemiological studies, it is essential to have a reference value, for the scientific reliability and statistical credibility, which is usually the limit set by WHO.

> **Geriatrics**: from the Greek words “geros” (old) and “iatros” (doctor): the branch of medicine that deals with prevention and treatment of diseases of the elderly, as well as with their psychological, environmental and socio-economic status.

> **Gerontology**: the science that studies the changes caused by aging.

> **Geragogia**: science that studies all possibilities to age at best.

> **Diet**. The term comes from Latin (diaita) and Greek (dìaita) and means lifestyle. It is also the political or parliamentary assembly of some States, and once it was the assembly of the Holy Roman Empire. It may be defined as the food that human beings, and animals in general, normally intake. We can use this term to identify a rule that suggests the quantity and the quality of food in different ways: e.g. to lose or gain weight or to achieve different results on your body, such as diets for athletes. Further, it can mean a temporary abstinence from certain foods or drinks.

> **Physical or motor activity**: it means any movement produced by muscle action resulting in an increase in energy expenditure.

> **Exercise**: repetitive and finalized motor sequence.

> **Fitness**: capacity or ability of individuals to carry out or support physical activities to a level from moderate to vigorous without complaining of fatigue;

> **Wellness**: This term comes as the set of "well being" and "fitness". Its true meaning remains an unsolved mystery in the field of wellness. We like the definition of physical and mental health in relation to health promotion.

> **Sport**: it comes from the English "Sport" (nineteenth century) derived from the Old French "Desport", which means pleasure or leisure or entertainment. It can be defined as the set of physical activities (exercises, games, competitions) performed individually or in groups, usually with a competitive spirit or sometimes with recreational intent. The recreational aspect may relate to those who actually practice sport, or more often, to the audience of fans who attend competitions.

> **Performance**: efficiency, result of sport or motor activity, in general. Motor skills that are essential for performance are joint mobility, coordination and conditional capacities.

> **Conditional capacities**: strength, endurance and speed are defined conditional capacity, as they are able to affect the motor performance, and in particular sport, and they are the energy component.

> **Strength**: it can be defined as an entity that produces a push or a pull on a body. We must remember that a body maintains its state of rest or uniform rectilinear motion until external forces act on it (Law of Inertia or Newton 1st law). When a force (F) acts on a body, it produces an acceleration (a) of the mass (m) of the body, which is proportional to the amount of the force and to the mass itself. Thus: F = ma. The unit of measurement is the Newton: N = kgm s^{-2}. 1 Newton is the force exerted by Earth on an object with the mass of 1kg.

> **Work**: work (W) denotes the product between the applied force (F) and the resulting displacement (s). Thus: W = Fs. The unit of measurement is the Joule (J = Nm). The work can be run at different speeds.

> **Power**: the speed at which a given work is performed is expressed by the concept of power. It can be defined as the product of force applied (N) for the speed of movement (ms^{-1}). It is expressed by the formula: P = W / t. The unit of measurement is the Watt (W = Nmsec^{-1}).

> **Lever**: human movement combines linear and angular displacements of body segments through a lever mechanism. The lever is made of a rigid segment, a hub and a pair of forces, the driving force (P, power) and the resistance force (R).

Starting from the definition of force (F = ma) we see that we can replace it with the following Ft = mat, where t is time. Being a = v/t, we obtain the following formula: Ft = mv. The first part of the equation is defined "momentum" the second "time". The momentum (M) of force (torque) is calculated by multiplying the force (F) for the distance (d) between the application point and the fulcrum of the force. Thus: M = Fd.

> **Centre of gravity**: the center of gravity (CG) is the point of a body on which the resultant of gravity forces acts, i.e. the weight of the examined body. The CG of the

human body in standing position is located at the level of L3-S1, just prior to the spine. Thus, to prevent the body from falling forward, the so-called antigravity muscles are constantly engaged (tonic action) during standing. Each body segment has its own CG, and each movement of body segments tends to move the CG of the entire body and to modify the conditions of balance.

> **Balance**: it can be static or dynamic. It is 'the ability to maintain, during the various activities of daily living, the body segments in a stable condition".

> **Muscle strength**: the magnitude of muscle strength depends on:

a) Muscle mass: (number of fibers that contract, physiological cross-sectional area or, simply, cross-sectional area, CSA). The CSA is a measure of the number of fibers that contract in a given muscle and, accordingly, of the number of actin and myosin filaments that interact.

b) Type of muscle involved: in "spindle" muscles, in which fibers are arranged longitudinally with respect to the central axis of the muscle, the CSA is the geometric cross-sectional area of the muscle; in "feather" muscles, in which fibers are arranged diagonally in relation to ' central axis of the muscle, the calculation of the CSA also depends on the "angle of the feather", i.e. the inclination of fibers in relation to the central axis of the muscle. Hence, "spindle" muscles have longer fibers, smaller CSA, faster contraction speed, greater shortening capacity and greater strength development when compared with "feather" muscles.

c) Initial fiber length: according to the length-tension relationship, the maximum force is obtained when the contraction begins when a muscle has a length slightly longer than that at rest, which corresponds to the overlap of actin and myosin filaments that allows an optimal interaction, with the maximal production of acto-myosin bridges (cross-bridges).

d) Type of fiber involved: type I fibers ("red" or "slow") show a slow contraction and relaxation speed, develop less strength and show later fatigue; type II fibers ("pale" or "fast") show a faster contraction speed, develop more strength and show earlier fatigue.

e) Speed of contraction: it depends on the neurological activation (firing rate, phasic or tonic motor neurons), on the load (strength-velocity relationship), on the type of fibers and muscle, on the metabolic state (size and number of mitochondria, oxidative enzymes, ATP, glycogen, electrolytes, temperature and PH).

> **Properties of the muscle**: they are represented by muscle excitability, conductivity, contractility, extensibility and elasticity.

Excitability: it is the ability to respond to a stimulus, either chemical or electrical or mechanical; the stimulated muscle responds by generating an action potential.

Conductivity: it is the ability to propagate the action potential along the muscle fiber: this leads to the contractile response.

Contractility: it is the ability to generate strength in response to an adequate stimulus. Once calcium is released into the fiber from the terminal cisternae (lateral sacks of the sarcoplasmic reticulum), it binds to troponin C, while troponin I is still bound to actin and tropomyosin is still bound to troponin T and covers actin's binding sites for myosin; then calcium weakens the link between actin and troponin I, which rotates producing a lateral shift of tropomyosin, which, in turn, results in the "uncovering" of actin's binding sites for myosin. Each mole of troponin and calcium "uncovers" seven myosin-binding sites. The shortening of the contractile elements consists in the sliding of actin on myosin filaments (Z lines approach each other) due to breaking and reforming of cross bridges between actin and myosin. The needed power is provided by ATP hydrolysis.

Extensibility: ability to stretch passively when subjected to a traction force.

Elasticity: ability to return to the original length after removal of the traction force.

These last two properties are mainly related to the visco-elastic components of tendons.

> **Types of contraction**: muscular contraction is defined as "isotonic" when the muscle contracts against a constant resistance: it may be "concentric" when muscle ends approach or "eccentric" when muscle ends move away. When muscle strength is equal to the resistance, the contraction is defined as "isometric": as there is no displacement, no work id s produced. In the case of "plyometric" contraction muscle cells produce work using the elastic energy accumulated during the previous contraction (as is the case for activities involving jumping and bouncing). Finally, contraction is defined as "isokinetic" when the angular velocity of contraction is constant.

> **Overload**: to obtain a conditioning effect, exercise load must be greater than that the body is normally used to support: hence, "overload". The training load should be measured not in absolute terms (external load: e.g. weight lifted, speed or distance walked), but in relative terms, as a percentage of the maximum load sustainable by a given subject for that particular type of exercise or activity (internal load). As the improvement of physical ability increases the maximum sustainable load, for the training load to continue to exert an overload effect, a progression of the training load is needed; the training load should be such to ensure at least the maintenance of the existing conditioning level.

> **Specificity**: the conditioning is specific for the energy system mainly developed, muscle group involved and gesture made. This means that:

a) exercises that use an energy system, selectively enhance that energy system: i.e. explosive power exercises, such as jumping, selectively enhance the ATP-PC system, while aerobic activities selectively improve aerobic training;

b) strengthening exercises that engage a group of muscles, selectively increase mass, strength and resistance to fatigue of that muscle group and not other muscle groups;

c) to improve a particular athletic or every day gesture is necessary not only to improve flexibility, strength and muscular endurance in the involved district, but it is also necessary to repeat several times that gesture to achieve the optimal neuro-motor coordination.

> **Reversibility**: "de-conditioning" causes the loss of achieved benefits, with a variable speed according to various parameters (VO_2 max, muscle enzymes, etc). In adults, the loss begins 3-7 days after the cessation of physical activity, with return to baseline in about 4-8 weeks; with age, the loss rate is even faster.

> **Energy Metabolism**: within certain limits, related to the fact that under the same type of physical activity we can have different phases, depending on the energy metabolism predominantly involved, we can classify motor activities based on the intensity and duration of the gesture as follows:

- predominantly anaerobic alactacid activities: the gesture lasts from a few fractions of a second a few seconds, as in the activities of explosive power (weight lifting, jumping, throwing, diving);

- predominantly anaerobic lactacid activities: the gesture takes from a few seconds to about 5 minutes (speed activities: running, cycling, swimming, etc). Can be divided into "pure" anaerobic (duration between 20 and 45 sec.) and aerobic-anaerobic massive effort (duration between 45 sec. And 5 minutes);

- predominantly aerobic activities: when the duration is more than 5 minutes and the intensity is submaximal (resistance activities such as a marathon, middle distance running, cross country skiing, aerobic dance, but also walking, swimming, cycling at a reduced speed or moderate and cardio-fitness using machinery) .

> **O_2 consumption**: tasks can also be classified based on the amount of energy they require, in METs. The MET is related to O_2 consumption per unit of time and it refers to basal metabolism. In humans 1 MET = 3.6 mLO_2/kg/min; 1 MET corresponds to 38-40 Kcal for square meter of body surface per hour. The equation used to switch from one unit to another is as follows: $1LO_2$ = 5kcal.

CHAPTER III

THE ASSESSMENT OF PHYSICAL ACTIVITY FOR THE ELDERLY

Claudio Macchi

III.1 Distinguishing features and contra-indications of motor activities.

Physical activity is often crucial in the prevention and treatment of many chronic diseases of the elderly (muscle wasting, abnormal joint flexibility, cardiovascular and respiratory de-conditioning, osteoporosis, etc.) (1). Despite its many positive effects, however, physical activity can lead to musculoskeletal and cardiovascular complications, especially if it is not performed under safely conditions. It 's the case, for example, of frail older persons, for whom a proper and balanced exercise program can be useful to reduce the risk of premature death, as well as the worsening of functional limitations and the development of disabilities (2). The possible occurrence of adverse events during the course of physical activity is significantly higher in patients with heart disease, in older, sedentary subjects and in individuals with a higher global cardiovascular risk (3). For these reasons, to take or prescribe effective and safe exercise programs, it is necessary to conduct a preliminary evaluation of the patient's health. This pre-assessment of health status consists of a set of investigations aimed at verifying the suitability of the individual to undertake a program of physical exercise under safety condition and at identifying the types of programs most appropriate to preserve the physical well being and to improve functional capabilities.

The procedures foresee an initial preventive screening, which must meet the criteria of efficiency, speed of implementation and applicability on a large scale.

Table I. III - Physical Activity Readiness Questionnaire (PAR-Q)
Reviewed by the Canadian Society for Exercise Physiology (2002)

Par-Q & YOU (Questionnaire of preventive screening for people aged between 15 and 69 years)

Fill out the following questionnaire honestly and accurately by using common sense and giving the answer YES or NO

YES	NO	
□	□	1. Did your doctor ever tell you that you have a heart disease and recommend that you only exercise with medical supervision?
□	□	2. Do you complain of chest pain when you exercise?
□	□	3. In the last month you have experienced chest pain while not exercising?
□	□	4. Have you ever lost your balance due to a feeling of confusion or have you ever lost consciousness?
□	□	5. Do you have a problem in your bones or joints that could be exacerbated by a change in your physical activity level?
□	□	6. Has your doctor ever prescribed medication for blood pressure or heart diseases?
□	□	7. Are you aware of any other reason why you should not performe physical activity?

• If there are one or more affirmative answers to questions by phone contact your doctor before you start exercising.

• If there are negative responses to any questions you can start physical activity slowly and increase intensity gradually.

Important Note: If your health changes during an exercise program, making it possible for a positive response to one of the above questions, talk with the professionals. If you are pregnant, ask your doctor before increasing their physical activity.

The aim is to identify subjects particularly at risk, especially the elderly, who often show many comorbidities and take drug therapy.

So we pay more attention to people with:

1. established medical contraindications to exercise;
2. multiple risk factors related to age and diseases;
3. symptoms which call for a specialist assessment of a second level, including the execution of more extensive instrumental testing;
4. clinically established disease whose exercise program requires the supervision of medical personnel.

With this regard, it should be remembered that preliminary investigations may consist of simple questionnaires, often self-administered, such as the PAR-Q (Physical Activity Readiness Questionnaire) which has been designed to be used before an exercise program of moderate intensity in subjects aged between 15 and 69 years

(Table I. IV). In general, these questionnaires contain quite simple and understandable questions and are reasonably efficient in highlighting possible conditions in which exercise might be contraindicated. In addition, even the American College of Sport Medicine and American Heart Association have published a questionnaire to analyze the relationship between health and physical activity (Table II.IV) (4). In the case the preventive screening shows a state of health that could jeopardize the safety of exercise programs, the person should be advised to consult a doctor or a specialist. Sometimes further diagnostic and instrumental investigations may be necessary. Evaluations may require the intervention of a specialist in cardiology, orthopedics, geriatrics, and include, along with medical history and examination, also additional diagnostic tests (X-rays, CT scans, MRI, ECG, Holter electrocardiogram; heart or vascular ultrasound scans, stress testing, spirometry, blood and urine tests).

Tab. II.III AHA/ACSM questionnaire for the preventive screening of health status.

Evaluate your health marking all true statements

Clinical history:
Have you had: X a heart attack X coronary heart surgery X angioplasty (PTCA)
X Pacemaker / implantable defibrillator X cardiac rhythm disturbances
X heart valve disease X heart failure X heart transplant X congenital heart disease
Symptoms:
X Have you ever experienced chest pain during exercise? X Have you ever felt the sensation of breathlessness? X Have you ever had dizziness, confusion or unconsciousness? X do you take drugs for the heart?
Other health conditions:
X Do you have diabetes? X Do you suffer from asthma or respiratory disease? X Do you feel burning or cramps in the legs when you walk short distances? X Have you musculoskeletal problems that limit your physical activity? X Are you anxious about the safety of physical activity? X Are you taking one or more drugs? X Are you pregnant?
If you marked any one of these statements, consult your physician before starting a physical activity. You may need to be followed by qualified medical personnel.
Cardiovascular risk factors:
X You are a man aged > 45 years? X You are a woman aged> 55 years, have you undergone hysterectomy, or are you in menopause? X Do you smoke or have you quit in the last 6 months? X Is your blood pressure higher than 140/90 mmHg? X You do not know your blood pressure. X Are you taking medication for blood pressure? X Are your blood cholesterol levels > 200 mg / dl? X You do not know your cholesterol levels. X Have your relatives had heart attacks or heart surgery before the age 55 (father or brother) or before 65 (mother or sister)
X Do you have a sedentary lifestyle (less than 30 minutes three days per week of physical activity) X Are you overweight by more than 10 kg
If you have scored two or more statements of this section, you should contact your physician before starting a physical activity. You can take advantage of the service offered by qualified personnel who will address the choice of a more appropriate exercise program.

None of the above:
You should be able to safely perform physical activity also without consulting your doctor or other qualified professional through a self-guided exercise program.

Contraindications to physical activity are represented by those conditions that limit the suitability of individuals to physical exercise as they expose them to a risk that is greater than the benefits that can be achieved.

Table III.III Main absolute contraindications to physical exercise (no exercise).

Cardiovascular:	Non-cardiovascular:
• Unstable heart failure (signs and symptoms of heart failure at rest or during mild exercise) • Recent (< 3 weeks) acute myocardial infarction • Acute myocarditis, pericarditis and endocarditis • Unstable angina • Severe, uncontrolled hypertension (BP > 180/110 mmHg) • Cardiac or aortic aneurysm with surgical indication • Uncontrolled arrhythmias • Severe, symptomatic aortic stenosis • Ongoing thrombophlebitis or deep vein thrombosis • Recent (< 3 weeks) pulmonary embolism • Severe pulmonary hypertension (mean pulmonary arterial pressure> 55 mmHg) • A-V Block II or III degree • Resting heart rate higher than 100 bpm	• Acute infectious states, fever • Respiratory failure • Severe, uncontrolled dysthyroidism • Severe uncontrolled psychotic states • Severe anemia (hemoglobin < 8 mg / dl) • Poorly controlled diabetes (blood glucose > 300mg/dl or > 240mg/dl with ketonuria)

Contraindications are divided into absolute and relative. In the first case, the subject is completely excluded from exercise programs. In the second, however, may be admitted if (but only after a careful monitoring) to a custom program and under the careful supervision of qualified medical personnel.

The conditions that contraindicate exercise, either absolute or relative, are, in turn, divided on the basis of the patho-physiological mechanism in cardiovascular and non-cardiovascular (Tables III.III and IV.III).

Table IV.III - Main relative contraindications to physical exercise (starting exercise program only after medical control)	
Cardiovascular • Chronic stable ischemic heart disease • Resting ECG abnormalities previously known (pre-existing left bundle branch block, ventricular preexcitation syndrome, frequent extrasystoles) • High overall cardiovascular risk (age> 45 years, with 2 or more risk factors) • Recent pacemaker/defibrillator implantation • Anemia in patients with cardiac diseases • Aortic aneurysm without surgical indication • Atrial fibrillation with heart rate > 100 bpm	Non-cardiovascular • Severe obesity • Hepatic or renal failure • Reduced functional capacity (<4 METs) • Chronic lung disease (emphysema, chronic bronchitis, some forms of asthma) • Complicated diabetes (retinopathy, nephropathy, peripheral vascular disease, autonomic and peripheral neuropathy)

III.2 Criteria for the exclusion of older persons from Adapted Physical Activity (APA) programs.

Although adapted physical activity courses are, as stated in the very term, "adapted" to the various chronic diseases, not all individuals with chronic diseases can participate. In general terms, always keeping as valid the explicit instructions from the table above, the following criteria has been adopted for the exclusion from APA programs:

- severe cognitive impairment;
- acute medical conditions or exacerbations (vertebral fractures, contraindications cardio-respiratory exercise, etc.);
- inability to walk autonomously;
- inability to cooperate and interact within the group;
- inability to reach the gym autonomously or with family support.

Once individuals eligible for undertaking physical activity programs have been identified, precautions must be taken to reduce the occurrence of musculoskeletal and

cardiovascular complications during motor activities. It is useful to remember that the absence of blood pressure increase during the work and the slow recovery of heart rate (HR) and ventilation after a bout of exercise are indicative of an impaired cardiovascular response. In particular, before starting each session of physical activity, it is essential to check the clinical stability of the individual and exclude the presence of lower limb edema, dyspnea, impaired balance with postural instability, chest pain, bluish skin (cyanosis), presence of whistling and wheezing (asthma). If these clinical signs are present before starting the exercise, or if they appear during the exercise, it is mandatory to contact the medical practitioner. During exercise, it is important to monitor vital signs to ensure that the blood pressure does not increase above 180/100 mmHg, that the heart rate does not exceed the target values and that the subject does not experience arrhythmias; these circumstances would entail discontinuation of the session and the intervention of the physician (cardiology visit, ECG, O2 saturation).

A safe physical activity program should include at least three phases: warm-up, exercise and cool-down. The warm-up should be progressive and involve both muscle and cardio-respiratory activities. In this way, it is possible to prevent musculoskeletal damages and reduce cardiac symptoms (5). The exercise should be tailored, with regard to intensity, frequency and duration, to the subject and gradually increased over time according to the functional capacity of the subject. The cool-down phase, or post-exercise cooling, increases the venous return to the heart in the recovery phase, avoiding hypotension. Finally, to safely perform a physical activity program, environmental conditions should also be taken in the due account. In fact, in too warm environments, heart rate and myocardial oxygen demand significantly increase. This phenomenon is accentuated in the presence of a concomitant dampness. Accordingly, in this environment, it is recommended to maintain adequate hydration, reduce the intensity of exercise and wear light clothing. Conversely, physical activity in cold environments causes an increase in cardiac output and work and produces vasoconstriction. The resulting increase in peripheral vascular resistance and blood pressure, associated with a reduction of coronary perfusion due to spasm, may induce a state of silent or symptomatic cardiac ischemia (6).

CHAPTER IV

The relationship between the didactic and the functional evaluation for the elderly

Raffaello Molino Lova - Francesca Cecchi

IV.1 Sedentariness and hypokinesis in the elderly

The negative effects of a sedentary life on the health of a person do not only affect his cardio-circulatory system, as widely shown by literary texts, but also the other organs and apparatus, so increasing the morbidity and the death rate. According to OMS, a sedentary life causes 1.9 million dead per year all over the world[1]. Moreover, 10-16% of cases of neoplasia of breast, colon and diabetes mellitus as well as 22% of cases of ischemic heart diseases[2] are ascribed to it. From a prevention point of view, it has been shown that eliminating sedentariness from the risk factors there may be a remarkable reduction of many diseases such as the cardiovascular ones (about 15-39%), ictus (about 33%), neoplasia of colon (about 22-33%) and bony fractures due to osteoporosis (about 18%). Considering that lifestyle in developing countries is becoming more and more similar to the one of the western world, sedentariness is becoming one of the main future risk factors. In Europe, sedentary life is the second risk factor for cardiovascular diseases soon after smoking. It is considered that about 30% of population is completely sedentary. Recent studies showed that more than 50% of people do not practice physical activity or has a sedentary lifestyle in Italy. These data are the same of those of the World Health Organization

It has been proved that a sedentary life double the risk of coronary health disease[3], while a regular physical activity helps prevention for cardiovascular diseases. Nevertheless, it has been noted that cardiopathic patients, who have practiced a physical rehabilitation in the hospital after a cardiovascular surgery, hardly go on practising physical exercises in the following months. Only 45-60% of people practise a regular physical activity one year after a heart surgery operation while even 30-50% of them do it 2-5 years after it[4]. So, it is really difficult to change people's lifestyle, considering that even those who had health problems because of their sedentary life do not practice a regular physical activity. The biological mechanisms, which link sedentariness to the above mentioned detrimental effects, are not totally clear yet. Probably they are due to negative changes in the cardiovascular system as well as to the negative effect of the main risk factors. Indeed, it has been proved that a sedentary life increases the risk of arterial hypertension, dyslipidemia, weight gain, and mellitus diabetes of II level [5,6,7,8,9,10]. Moreover, it has been recently proved that few weeks of sedentary life can alter the enzyme activity of the oxidative stress and the endothelial function, involved in the atherosclerosis [11,12,13,14].

Finally, people who have a sedentary life suffer more mood troubles, like anxiety and depression, which have a great deal in the pathogenesis and the prognosis of cardiovascular diseases[15].

Hence, a physical activity protects the body from many diseases, particularly the cardiovascular ones, as the studies of the effects of a primary and secondary prevention have widely shown.

With regard to the primary prevention it has been shown that a regular physical activity, which may improve the physical performance of a person, reduce the mortality rate to 50%. At the same time, it has been shown that physical fitness particularly helps sedentary subjects with a higher mortality risk. [16,17,18]. Moreover a regular physical activity improves and extends the life of individuals even at the presence of risk factors such as overweight, hypercholesteremia and diabetes. The Harvard Alumni Healthy Study[19] showed that the risk of death can be reduced up to 20% through a strong physical activity that leads to a consumption of 4.200 KJoule per week (that means 30 minutes of fitness a day for at least 4-5 days a week). It also showed that the greatest reduction of the risk is achieved practicing exercises of moderate intensity, as 3-5 hours of walking, 2-3 hours of jogging or 1-2 hours of running a week. To fully understand the importance of physical activity in secondary prevention after a cardiovascular surgery, we can quote a recent and wide meta-analysis[20] based on the data of Cochrane Library about patients who followed heart rehabilitation programs. This analysis has indeed confirmed a significant reduction of the overall mortality, even due to heart diseases in patients with ischemic heart diseases and participating in rehabilitation programs based on the physical activity.

Finally, it is important to consider that a regular physical activity not only affects the single subject but also the whole community in terms of sanitary economy. In fact, it has been shown that sedentary life not only causes many diseases (table no. I.III) but it is also responsible for about 250.000 untimely deaths every year, which means a cost of 1.000 billion US dollars (US$)[2,21]. If 10% of sedentary adults of both sexes and aged between 35 and 74 started to walk at least one hour a day, the yearly costs of the health economy for coronary diseases would be reduced of 5,6 billion US$[22].

Disease	**Yearly Cost** (md UsD)	Changed by: Booth FW, Gordon SE, Carlson CJ, Hamilton MT. Waging war on modern chronic disea- ses: primary prevention through exercise biology. J Appl Physiol 2000;88: 774-87
Arterial Hypertension	286	
Overweight	238	
Diabetes m.to type 2	98	
Colon Cancer	107	
Osteoporosis	6	
Lumbosciatica	28	
Calculosis	5	

Table.I.III. Diseases caused by a sedentary life and their respective costs[23].

IV.2 Physical and cardiovascular activity

The cardiovascular activity may be steady over the time, as, for example, in prolonged aerobic training (walking, marathon, cycling, etc.), or intermittent one, like, for instance, tennis, soccer and basket.

Cardiovascular commitment obviously depends on the intensity of the effort, which is proportional to the metabolic demands of the muscles involved. MET (metabolic equivalent of task), or simply metabolic equivalent, is the measure of the intensity of physical activities and of the metabolic demands. 1 MET is the amount of oxygen consumption (VO_2) of a subject while at rest: it is about 3,5 ml of O_2 /kg/min. An exercise which requires a 3 MET energy consumption is a low intensity activity (like walking or slowly swimming), an exercise requiring 3-6 MET is a moderate intensity activity (like, for example, walking quickly or uphill), a 6 or more MET exercise is a high intensity activity (that's VO_2 of 21 ml/kg/minute). The hemodynamic response to stress is mainly influenced by the type of exercise. In dynamic activities, such as walking, running and cycling, the technical gesture is cyclic and the strength of the muscles involved generally is not very high. During these aerobic activities, when the effort is slight or moderate, muscles mainly use the energy got from the oxidation of lipids, while for higher intensity activities they primarily utilize stores of carbohydrate products, in the form of glycogen.

These activities are featured by an increase of the heart rate (HR), which is proportional to intensity of the effort, and by a peripheral vasodilation, with little or no increase in average blood pressure (BP).

These activities are preferred to other exercises in the primary and secondary prevention field, even considering that they may be adapted according to simple and reliable parameters, such as, for example, the heart rate, and so they may be better performed by older persons. Anyway, every activity can be performed at high intensity, a condition that has to be avoided during therapeutic and preventive trainings. They differ from static or intense activities, that are the anaerobic exercises, when muscles use phosphocreatine and just few carbohydrates through glycolysis, producing the lactic acid. It has been shown a cardiovascular response performing those exercises mainly featured by an increase of the average blood pressure, due to the increase of the peripheral vascular resistance, which can be particularly dangerous for hypertensive subjects and/or subjects who suffer hypertension and/or aortic problems (like, for example, aneurysms).

The risk of cardiovascular complications while performing prolonged or intermittent physical exercises is more or less the same.

The epidemiological studies of sudden death while performing physical activities have shown that the intensity of the exercise is the main factor of the risk itself. Actually, in the elderly, a regular physical activity has beneficial effects on the cardiovascular system, when the intensity doesn't exceed 70-75% limit, without any significant increase of the risk. Of course, this "threshold" changes according to the age and at the presence of a heart disease. In these cases, it is necessary to better define the

intensity of the suggested effort, considering that it may be difficult to quantify the factor competition and the risk of opposing responses to the exercise, like arrhythmia, while performing some intermittent exercises.

Dynamic training activities with a constant cardiovascular commitment

These physical training activities are simple actions as walking, running outdoors or on the treadmills, cycling, swimming in a swimming pool. Before prescribing this kind of exercises, it is important to consider the intensity of the effort, too. A health certificate is demanded by law when performing moderate or high intensity sport activities (competitive sports).

Dynamic training activities with an intermittent cardiovascular commitment

They are more complex gestures which demand a fair technique (tennis, soccer, five-a-side soccer). They exert beneficial effects on the body and on the cardiovascular system but they are more difficult to dose because of their competitive feature, unavoidable even if they are performed for fun.

Static Strength training exercises.

They significantly increase blood pressure. They are, for example, weight lifting or body building exercises. It isn't clear yet if, under particular conditions (as when they are performed in a dynamic way, with many repetitions and low loads) they have beneficial effects on the cardiovascular system. In any case, they cannot be considered first choice activities to prevent cardiovascular diseases.

NOTE: The response of our body to physical training includes the control of breathing, of the cardiovascular system, of mood, of the nervous system and of the muscles. It is a function of the physical and health condition of the subject and of the type of the training exercise performed.

IV.3 Outlines of the Physiology of the Physical Exercise and energy consumption[24]

The performance of the muscles during the training activity depends on a fair response of the cardiovascular and respiratory systems to the increased metabolic demands of our body. When the mechanism, which uses our energy substrates, is more efficient, the stress of the whole system is lower when it reproduces the energy required for a particular exercise.

So, every complex mechanism linked to each other, which matches the external respiration with the cellular respiration, is indispensable to perform a particular exercise.

Any change involving a link in this chain causes an altered metabolic response and, when the change is particularly serious, there may be a heavy limit in the functional response.

Gas exchange

An effective gas exchange between the cells and the environment depends on the following factors:

Intact cell structure, presence of energy substrates, adequate concentration of the enzymes involved in the cell respiration;

Heart with a good pumping activity;

Efficient circulatory system, which can distribute blood to all the tissues which more need energy;

Blood with a hemoglobin content which is considered normal from a qualitative and quantitatively point of view;

Efficient pulmonary circulation, which connects blood to ventilation;

Normal thoracic structure, which allows a normal pulmonary activity;

Mechanisms to control ventilation which can control the partial pressures of arterial gas and the blood PH.

The skeletal muscle may be considered as a "machine" which refuels itself using the energy coming from the food and stored in the form of carbohydrates and lipids inside the body. The proteins, which are an excellent source of energy, however, are not used for energy purposes, except in conditions of extreme food deprivation.

Carbohydrates are oxidized with a respiratory coefficient equal to 1, that means that the oxidation process uses six molecules of oxygen and produces six molecules of carbon dioxide as waste. Hence, the relationship between the production of high-energy phosphates and the oxygen consumption is equal to 6.0 or 6.18, depending whether the oxidation concerns respectively the glucose or the glycogen:

$C_6H_{12}O_6 + 6\ O_2 = 6\ CO_2 + 6\ H_2O + 36$ o 37 ATP

Lipids, as palmitate, are oxidized with a respiratory coefficient equal to 0.71, i.e. 23 molecules of oxygen and 16 waste molecules of carbon dioxide are needed to oxidize one molecule of palmitate. In this case, the relationship between the production of high-energy phosphates and the oxygen consumption is 5.65, i.e. 130 molecules of ATP produced for 23 molecules of oxygen used:

$C_{16}H_{32}O_2 + 23\ O_2 = 16CO_2 + 16\ H_2O + 130$ ATP

Therefore, the respiratory coefficient of the intermediate metabolism reflects the several proportions of carbohydrate and fats used during the metabolic process. Fats are the best way to store energy inside the body. On the contrary, carbohydrates are better with regard to the consumption of oxygen needed by the reaction. In conditions of balance, as mentioned previously, the respiratory coefficient accurately reflects the metabolic one. During a moderate physical activity the metabolic quotient of the muscle can be approximately expressed by the increase of VCO2, concerning the increase of VO_2. According to these measures, it has been established that the metabolic quotient of the muscle during a physical activity is about 0.95. Hence, the muscle uses much more sugar than fats during the physical training. Of course, the situation changes in a rest condition. The metabolic quotient of the muscle is quite high if compared to those of the other organs (except the brain) and it helps the metabolic quotient of the whole body in a decisive way. Approximately the metabolic quotient (QR) goes from 0.8, during a rest condition, to 0.95, during a moderate intensity activity. A 0.95 RQ means that about 84% of substrates consumed for that type of

exercise consists of carbohydrates. Anyway, even if the "mixture of fuel" used by our body during a physical activity derives more from the reserves of carbohydrates than from the lipids' ones, the QR slowly and gradually decreases during a long physical exercise at a constant workload. This trend of the QR over the time reflects the gradual reduction in the use of carbohydrates as substrate during the exercise and this depends on the progressive depletion of the stores of muscle glycogen. When the stores of glycogen are over, the subject feels stressed and very tired and so the exercise ends. The ingestion of glucose allows the muscle to continue its work. Bergstrom and his coworkers showed that the higher is the rate of muscle glycogen, the higher is the resistance to a high-intensity exercise. It has been proved that the fitness training can influence the use of the energy substrates. Actually, a trained person (fit) compared to a no-fit one uses more fatty acids as energy substrate to perform a sub-maximal work. This mechanism saves the reserves of glycogen and so makes them available for a longer time, so allowing a longer physical exercise.

The human skeletal muscle contains from 80 to 100mmol (15-18g) of glucose per kg of wet mass, stored as glycogen. Therefore, a standard person of 70kgs has about 400g of muscle glycogen. Anyway, this is only a total evaluation of the pool of carbohydrates of the skeletal muscles, so a muscle contraction will rely on a lower quantity of glycogen or only on its own reserves. Normally there are from 5 to 6 g of glucose in the blood (100mg/100 ml). During the exercise, although the muscle mass increases the consumption of glucose, its plasma concentration remains constant thanks to the mobilization of sugar from the liver stores, except during a prolonged physical activity. The liver glycogen, approximately 50-90 g, is converted into glucose through the glycogenolytic process. Glycogen stores can be recovered through the process of gluconeogenesis using lactate, pyruvate, glycerol and alanine precursors. The amount of glucose released depends on the plasma concentrations of glucose and strictly by the complex hormonal interactions of insulin and glucagon, and by the action of catecholamines such as adrenaline and noradrenaline.

As the intensity and duration of the exercise increase, the levels of circulating catecholamines and of glucagon increase too, in order to keep blood sugar levels steady despite the increased use of glucose by muscles tends to push them down.

The fatty stores of the muscles amount about to 20g of triglycerides per kg of wet mass.

During the exercise both the resources of lipids contained in the muscles and the extra muscle are used, such as the adipose tissue, where triglycerides undergo a hydrolysis process that converts them into glycerol and free fatty acids, mainly palmitic, stearic, oleic and linoleic. Fatty acids are transported in plasma mainly by the abumin. On an extra-muscular level, there are big stores of lipids: in a standard subject, weighting about 70 kgs, the fatty mass is about 15 kgs of triglycerides, equivalent to about 135.000 Kcal of energy. The sympathetic nervous system along with catecholamines released from adrenal gland medullary regulates the lipolysis in adipose tissue.

The adrenaline and the noradrenaline increase the local concentration of the cyclic AMP through the activation of adenylate cyclase. This leads to an increased hydrolysis activity of the triglycerides stored in the adipose tissue. Other factors, on the contrary, reduce the lipolytic activity during the exercise, such as the increase in plasma lactate and any glucose load from outside. Free fatty acids represent only a small part of the pool of plasma fatty acids, the remainder is made up of triglycerides. Plasma concentrations of free fatty acids is around 0.5 mmol / L in a rest condition, it increases to about 2 mmol / L during a physical activity. The turnover of the pool of plasma free fatty acids is high, with an average time of 2-3 minutes at rest and it decreases during a physical exercise. Consequently, the main determinant of the uptake of fatty acids in the muscles is determined by the product of the blood flow to the plasma concentrations.

Physical training slightly decreases the plasma concentrations of fatty acids. Hence, a possible increase of the oxidation of free fatty acids for the energy mechanisms of the body, measured at a specific workload after training, may be a sign of an increased use of the muscles resources. In conclusion, the lipolysis of the adipose tissue does not increase with the physical training, it may indeed be slightly and gradually lowered by the person himself.

With regard to the use of the amino acids resources during the exercise, it has been noticed that the alanine is the only amino acid significantly released into circulation by the muscle tissue during the exercise. On the contrary, there is no or just a slight increase of all the other ones. The increase of the circulating alanine derived from the muscle largely depends on the transamination of pyruvate, which derives from the increased metabolism of the glucose. The amino groups derive from the deamination of the inosin-monophosphate during the synthesis of purine nucleotides and by the branched chain amino acids (valine, leucine and isoleucine). It has been shown a linear relationship between plasma concentrations of alanine and pyruvate, both at rest and during a physical activity. Therefore, probably the increase of the circulating alanine shows more an increased metabolism of the glucose than an increased use of proteins for energy purposes. Alanine develops through the process of muscle transamination and it is transported through the bloodstream to the liver, where it is used as a precursor for gluconeogenesis. Hence, there is an alanine-glucose exchange between the muscle and the liver, that means that the "skeleton of carbon" of the alanine is used in the synthesis of hepatic glucose.

IV.4 Physical Activity, energy consumption, and assessment tools [24]

The oxygen consumption during an activity depends on the intensity of the work itself. Observing the time dependent changes in the consumption of O2 while cycling, when the workload is constant, it comes out that workloads $\leq$ 150 watts, for steady state VO_2 was reached within the first 3 minutes of the exercise. For workloads of more

than 150 watts, the O_2 consumption continues to rise even after 3 minutes. In a working range between 150 and 400 watts, the higher is the workload the greater is the consumption of oxygen. However, over 200 watts, the peak VO_2 doesn't change thus indicating what is the highest VO_2 of the subject. Once this level has been reached, the oxygen consumption cannot rise more; a person cannot perform a physical activity at the level of his highest VO_2. The relationship between the oxygen consumption and the workload is linear and its slope is approximately the same for every person, that is about 10 ml / min / watt, showing that the effectiveness in performing a physical activity is comparatively steady. Anyway, while the slope between VO_2 and workload is not connected to the training, the age and the sex of a person, on the contrary, it definitely depends on his weight, so much that it is important to consider a greater oxygen consumption of about 5.8 ml/min/kg in overweight people. This reflects the additional work that the person has to do to move a heavier mass. The effect of the body's weight on the oxygen consumption is even more evident while training on a treadmill, when the subject has to move his entire body mass. The efficiency of work varies only slightly from person to person. Trained subjects or not, young and old, male and female, everybody has his own comparable efficiency of work.

The cardiopulmonary exercise allows the simultaneous assessment of the ability of the cardiovascular and respiratory systems in carrying out their primary function, i.e. to ensure a gas exchange between the environment and the body's cells. Since a physical exercise demands an integrated answer of the two systems to face the increased metabolic needs due to the exercise itself, measuring the gas exchange is essential to understand the limits to train. The cardiopulmonary test allows the simultaneous measuring of the cardiovascular and respiratory systems. The test requires an ECG record during the exercise, the control of the heart rate and of the blood pressure. Hence, the responses of the cardiovascular system to the physical exercise are compared to the data given by the gas exchange. During the exercise, the cardiovascular and respiratory systems have to face the increase of the cell respiration at a muscular cell level, i.e. their increased demand of oxygen and increased production of anhydrite. Therefore, according to the pulmonary response to the exercise, it is possible to define correctly the functional competences of every apparatus involved in the physical activity; that means it is possible to control the health. The cardiopulmonary test is the only possibility to study simultaneously the cell, the cardiovascular and ventilation responses to the physical exercise. The ergometer tests, which don't study the gas exchange, can't practically evaluate the effectiveness of the previous mentioned apparatus, whose main aim is to support the cell respiration and so the life of the body. A reduction of the VO_2 peak may be caused by any disease, which affects the skeletal muscle, and all the organs that carry the oxygen and CO_2 between the air and muscular cells. As previously mentioned, the main function of the cardiovascular and pulmonary systems is to support the cell respiration. The cardiopulmonary test, referring to specific parameters, checks the physical performance of a person.

Since it is the most effective tool to get complete and detailed information about the physical activity in the research field, the cardiopulmonary test is particularly useful even in a medical field. Its main uses are the following ones.

Differential diagnosis: when the cause of dyspnea or the limitation of the performance is unknown, the CPET can help you in identifying the cause of a bad gas exchange.

Assessment of disabilities through an assessment of the exercise ability and of the level of functional limitation of a person.

Rehabilitation: The CPET provides information regarding the level of effort that a person can sustain without stress. It is therefore of fundamental importance in defining the physical rehabilitation and the evaluation of the benefits derived from this. In fact, an increase in the exercise tolerance cannot really be detected without a cardiopulmonary exercise test.

Defining the pre-surgery risks: the CPET carefully defines the risks someone may be exposed during an important surgery. In fact, it gives details about the metabolic reserves of a stressed body.

Evaluating the seriousness of a heart failure: the peak oxygen consumption is an accurate survival indicator for the patients who suffer of a heart failure. Two more important parameters taken by the cardiopulmonary test have been recently identified as indicators of the prognosis: they are the ventilatory equivalent of CO_2 (VE/VCO_2) and of the anaerobic threshold (AT). Moreover, it is also an essential tool to provide a detailed indication of the subjects decompensated heart transplant.

To grade the prognosis of patients with COPD: the VO_2 peak was identified as a survival predictor in patients with pulmonary better than FEV_1.

Evaluating the effectiveness of the therapy.

There are two main groups of protocols to make a cardiopulmonary test: those with constant load and those with an incremental load.

The protocols under constant load have scientific importance but little importance clinically. The most useful information is got at the beginning of the exercise and it is linked to the necessary time to get the new "steady state" condition as to the basal. This time is a function of the cardiovascular efficiency. Similar information can be obtained studying the kinetics of the oxygen consumption in the recovery phase, which is also a function of the cardiovascular system.

Departing briefly from the cardiopulmonary test, it is worth recalling in this context one of the most popular test to functional assess the exercise, because of its simplicity and low cost. This test, although it is a constant load test, provides useful clinical information about the health of a person. It is the 6 minutes walking test (test-6mwt), which is based on the distance covered in a specific time. For example, in patients with a heart failure the distance walked in 6 minutes is a prognostic indicator independent from NYHA class and the ejection fraction of the left ventricle[25].

Going back to the cardiopulmonary test, the protocols with a continuous increase provide information about specific moments of the exercise, such as the anaerobic threshold and the kinetic of ventilation and breathed out gases, their mutual relationships

(VE/VCO_2) and the relationships with the workload (VO_2/watt). The protocols with an inconstant load are particularly useful when specific evaluations about a specific load are needed, such as the determination of the cardiac output (GC) and pulmonary pressure. The parameter used is VO_2 peak. The protocol with an incremental load necessarily requires a session called "familiarization". There have been reported even 25% of differences between the VO_2 peak recorded during the first test and that of the second test made by the same person. Too short tests (with a too fast increase of the workload) or too long tests (with a too slow increase) influence the results[26]. The ideal length of an incremental test is about 10 minutes. It is not easy to understand the workload at which a person reaches the peak of the exercise. Anyway, it is important to define it because all the parameters change according to the length of the test[26], except VO_2 at the anaerobic threshold and the relationship VE/VCO_2. An incremental protocol provides many parameters to evaluate the exercise and much information about the physiopathology of the apparatus involved in the exercise. The following ones are the main characteristics of the most important parameters measured during a cardiopulmonary test.

The VO_2 peak and the exercise peak are the best-known parameters got by the cardiopulmonary test. They define different aspects of the exercise and so they do not have to be mixed up. VO_2 peak (VO_2 max) is the VO_2 value measured when, even if there is an increase of the workload, the O_2 consumption doesn't change. Clinically, unlike in a healthy subject or in an athlete, VO_2 max is hardly reached. For this reason, in the analysis evaluation, it is often replaced by VO_2 peak, defined as the highest VO_2 ever reached during a particular effort. It is important to consider that VO_2 is given by the cardiac output (GC) by the artery difference O_2 ($C(a\text{-}v)O_2$) and, since in a health subject the increase of $C(a\text{-}v)O_2$ has a linear trend with the increase of the workload[27], it is possible, knowing the VO_2, to estimate the GC increase. In 1985 Weber e Janicki[28] made a list of the functional abilities of patients with chronic heart failure, which is still used, based on VO_2 peak adjusted according to the body's weight. This classification had the merit to be the first one in the functional definition of a decompensated subject; unfortunately it did not consider the age, the sex and the fitness level of the studied subject. Moreover, despite the standardization of the body's weight, it doesn't consider that the VO_2 fat mass is different from that of the lean body mass. For this reason, there is an undervaluation of the VO_2/kg really achieved in overweight subjects. Simply considering VO_2 in ml/min/kg, it can be assumed that a VO_2 peak <10 ml/min/kg corresponds to a serious prognosis and a VO_2 peak > 16 ml/min/kg to a favorable prognosis. The prognostic evaluation of patients who have a VO_2 peak between 10 and 16 ml/min/kg should also consider other parameters.

The VO_2, at the anaerobic threshold, is a good predictor of the exercise ability and it is not connected to the duration of the effort. The best way to calculate the anaerobic threshold (AT - Anaerobic Threshold) is the V-slope, which connects VCO_2 and VO_2 .

To exactly evaluate AT, the experts recommend to confirm AT calculated with the V-slope analyzing the equivalent fans for oxygen (VE/VO_2) and those for CO_2 (VE/VCO_2).

The anaerobic threshold is given by the time the VE/VO_2 increases and VE/VCO_2 stays constant.

The relationship VO_2/workload is used to evaluate the cardiovascular performance. A reduced VO_2/workload shows a worse performance because the quantity of energy produced anaerobically is fewer.

The higher value of VO_2/workload seems to be fixed, because the athletes can extend the exercise but cannot increase the slope of the relationship VO_2/workload. This report is flattened when the GC increase or its distribution in the periphery is not enough. The normal value of the report VO_2/workload is ~10 ml/min/watt.

The oxygen pulse, i.e. the relationship between the oxygen consumption and the heart rate (VO_2/FC) is a sign of heart performance. It is given by the result of the systolic volume of the left ventricle by the O_2 difference arteriovenous.

The oxygen pulse increases mainly in the first part of the exercise, while in the second part it doesn't change. In this phase the GC increase is mainly due to the increase of the heart rate.

The product of VO_2 and the systolic blood pressure gives the "cardiac power", which is also used as an indicator of the left ventricular performance. This parameter has recently been considered a powerful prognostic predictor of patients with chronic heart failure.

The cardiac output (GC) and its changes during the physical training indicate the seriousness of the disease and it has even a greater prognostic value than the peak VO_2. In fact, the prognosis can be favorable despite the reduced VO_2 peak if the increase of the GC induced by the exercise is kept. In these cases the reduced VO_2 peak may depend on a concomitant and probable muscular deconditioning.

The possibility to evaluate the cardiac output in a no invasive way represents one of the greatest diagnostic news in the cardiology field[29].

During the exercise, there is an increase of the ventilation due to increase of the current volume and of the breathing rate. The increase of the current volume is particularly remarkable at the beginning of the exercise, while the increase of the respiratory rate is mainly remarkable at the end of the exercise. In patients with heart failure there is a greater increase of the ventilation during the exercise. It is due to increase of the respiratory rate which compensates the reduced increase of the current volume[30]. The causes of iperventilation in the heart failure are many: the change of the thoraco-pulmonary process, the reduced alveolus-capillary diffusion, the increasing necessity to ventilate because of the excessive increase of the CO_2 production, the increase of the death space, the excessive activity of the excessive activity of metaboreceptors, of chemoreceptors and baroreceptors.

The flow/volume curve allows to study properly the respiratory process during the exercise. Thanks to these curves it has been possible to document the existence of a respiratory flow limit even in patients who had heart failure and who, differently from normal people, have to increase their remaining functional ability to increase ventilation during the exercise [31,32].

CHAPTER V

The methodology of adapted physical activities for older persons

Paola Aiello[*] *- Claudio Macchi*

V.1 Methodological framework and educational information

The recommendations are based on studies lasting 6-12 months in which healthy older persons participated to various programs of aerobic activity. The increase in VO2max is directly related to frequency, intensity and duration, as well as to individual genetic characteristics.

The classification of the intensity of aerobic exercise can be based on the increase produced in heart rate, compared to the maximum heart rate (MHR = Maximum Heart Rate, calculated by the formula 220-age in years), or on the threshold of perceived exertion as expressed by the Borg scale.

The Borg scale, owes its name to Dr. Gunnar Borg in the fifties introduces the concept of perceived exertion, by developing two scales, the RPE (Ratings of Perceived Exertion) and CR10 (Category-Ratio anchored at The Number 10). The RPE scale is considered easier to administer and score.

The RPE is used to evaluate the subjective perception of stress in relation to the same amount of effort, with 15 possible scores (from 6 to 20). The Borg score corresponds ideally to heart rate during physical effort: the lowest value of scale (6) corresponds ideally to 60 beats per minute, while the highest value (20) corresponds to a heart rate of 200 beats per minute.

The Borg scale is a simple and safe method to assess the perception of stress. For example, you can stop a test when the subject feels a particular effort.

In order for the Borg scale to be reliable, the amount of perceived exertion corresponding to each score must be clearly explained to the person that shall be tested. The opinion given by the subject should be as objective and honest as possible without over-estimate or underestimate the effort.

The table I.V. correlates heart rate with the Borg scale, for instance a score of 16 corresponds to 85% of maximum heart rate, that in turn corresponds to the anaerobic threshold.

An even more simple and practical method is to maintain the ability to converse with the training partner (if present) or talking loudly during training; the loss of such an ability during a physical effort has been correlated with the beginning of lactate accumulation (the threshold of blood lactate accumulation, corresponds to the concentration of lactate of 4 mmol / L and should correspond to a level 11 on the Borg scale RPE).

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[*] **Paola Aiello**, author of the paragraph : "Didactics technologies for the elderly: virtual environment role in balance training", edited the development of the didactic dimension of the whole chapter.

The intensity of effort can be expressed in METs (multiples of the equivalent energy costs borne by the basal metabolic rate), calculated through dedicated tables. Compared to previous recommendations, it is now accepted that the benefits of training can be obtained, for sedentary people, even starting with an intensity of 55% MHR, corresponding to 40% VO2 max.

The recommended intensity of exercise is between 55 and 90% MHR or healthy adults, while elderly persons are advised to stay below 75-80% MHR (11-13 RPE), and to decrease intensity if they realize they are no more able to talk without effort during the training sessions. Sedentary, smoking elderly people must start at lower intensity.

The total workload (kcal) for each training session is the product of the intensity for the duration of the session: although the relationship is not fully elucidated, it is possible to think that we can modulate the initial activity in untrained subjects by reducing increasing the intensity and increasing the duration; the recommended duration, for an intensity between 55% and 80% MHR, ranges between 20' and 60'. The increase in VO2max increases with increasing frequency of sessions to reach a plateau above 3 sessions per week.

RPE INTENSITY SCALE (BORG)		
6	Nothing at all	20%
7	Very, very light	30%
8		40%
9	Very light	50%
10		55%
11	Fairly light	60%
12		65%
13	Somewhat hard	70%
14		75%
15	Hard	80%
16		85%
17	Very hard	90%
18		95%
19	Very very hard	100%
20	exhaustion	

Tab.I.V

Regarding the training mode, any aerobic activity involving large muscles, rhythmic and maintained over time, produces the benefits of aerobic conditioning (walking, cycling, skiing, swimming, aerobic dance). Running is not recommended for excessive impact that follows the phase of impact after the flight phase, on the foot, ankle, patella (for the internal rotation of the lower leg pulling inward and the quadriceps pulling outward result in a higher pressure applied to the patella against the lateral condyle of the femur), hip and lower back.

Football, ice hockey, skating and skiing are all sports that tend to put a high stress on the knee joint. The latter in particular, is associated to a high risk of knee injury, especially anterior cruciate ligament tear, that, in turn, increases the risk of damage to the meniscus.

Those who report knee problems should avoid or cautiously practice high impact activities, including dances that involve jumping, preferring instead swimming, cycling, rowing. In short, all those activities that involve strength training and aerobic energy expenditure reducing joint overload.

The effects of aerobic workout conducted according to the ACSM recommendations are as follows:

- Increase of 10-15% VO2max (starts from the first week);
- Increase of lactate threshold by 10-20%;
- Increased of hypoglycemic action of insulin;
- Improvement of muscle oxidative capacity;
- Stimulation of fat oxidation;
- Promotion of cardiovascular fitness and weight control (linked to the diet).

Aerobic exercise is recommended for diabetes, hypertension, obesity, osteoporosis, osteoarthritis (low impact exercise).

With regard to the maintenance of effects, a significant loss of aerobic benefit is evident after two weeks of the suspension of training, with a return to baseline levels of aerobic capacity by eight months at most.

V.2 Limits and recommended sport activities for the elderly: the example of cycling

As the prevalence of hip and knee OA is age-associated, the use of the bicycle is a highly recommended physical activity for the elderly, as the impact on weight bearing joints is reduced and the potential to increase mobility as well as self-confidence. According to the ACSM recommendations, it is advisable to start gradually, with an intensity of 60% MHR, for 30-40 minutes per session, and to remember heating before and cooling after the ride.

To avoid pain in the buttocks and knees, it is very important to adjust the height and size of the saddle. Further it must be considered that if the seat is too wide, we end up swaying from side to side; so, there may be more friction and thus more pelvic problems. More than an adequate padding, it is important to distribute the weight evenly, and to avoid overloading the buttocks. Attention must also be paid to regulate the height of the seat. A saddle set too low implies an excessive withdrawal of the legs, too high stresses the knee.

The mechanical efficiency of cycling is high, averaging 40%, about three times that of racing and eight times that of swimming. This implies a low energy expenditure per distance travelled (long distance covered at low cost); to obtain a significant energy expenditure (for example, within a program of losing body weight) is necessary to travel much greater distances than in swimming or running. The air resistance in

relation to driving speed is higher on average than in running, especially in windy conditions, which may be against or in favour to the rider. The aerodynamics of the bicycle is mostly important but a role is also played by the friction between the body surface and the air (for this reason professional cyclists shave or wear low-friction sportswear).

Cycling is a predominantly aerobic exercise that selectively engages the lower limbs, although in the competition the anaerobic component is also involved (20% or more in energy expenditure).

In the workout of the cyclist a variety of factors should be considered:

- Strength and leg muscle power (proportional to the cross section of the muscle and the lever arm in pushing on the pedal);
- Agility (economy and efficiency of athletic gesture);
- Aerobic capacity;
- Resistance to muscle fatigue;
- Ratio length of body / limbs: the cyclist is usually slender, only pure sprinter can be sturdy;
- Ratio length thigh / leg: the thigh is a pushing that works mainly on strength, and the leg as a rotation lever that works mainly on the rotation speed.

The work in cycling may involve strength, agility and endurance.

The muscles involved in cycling (stage push / pull phase) are:

1. Rectus femoris
2. Large medial and lateral
3. Sartorius
4. Tensor fascia lata
5. Hamstring
6. Gracilis
7. Tibialis anterior
8. Soleus
9. Gastrocnemius

In regular cyclists, it is important to assess the position of the foot on the pedal (metatarsal support), and to verify the seat position forward and height to be appropriately adjusted, to avoid overloading the knee and ankle.

The position of the foot pedal must be level of the metatarsal, as, if the first metatarsal head is too advanced, the mobility of the ankle joint during cycling is reduced, and the Achilles tendon, patellar tendon and quadriceps may be stressed.

The saddle should be adjusted so that at the end of the boost phase the leg is fully extended, but slightly bent, with a thigh-leg angle of 25 °-30 °, because a lower angle (lower limb fully extended) would lead to excessive stress on the knee in extension and would be disadvantageous from a mechanical standpoint, conversely a greater angle would apply too much stress on the patello-femural joint and the patellar tendon.

The position of the seat must be such that the subject is seated properly support the foot on the pedal with the crank horizontal and the vertical line from the front and

back of the patella (knee-axis crank), respectively, falling back and forth at the heart of the pedal but within the support area of the foot on the pedal; if this line crosses the patella, or it falls too backward, the knee will work in a mechanically disadvantageous condition and at greater risk of injury .

The knee joint is the most stressed in cycling, most at risk of overload injury if the knee in malaligned (varus or valgus). In these cases, it may be considered a correction of the support of the foot to reduce the asimmetric strain of the medial compartment. As to the spine, a higher risk of low back pain in cyclists has not been shown, but athletes have an increased risk of neck pain because of the hyperextension of the neck in racing.

It is also essential to assess the shape and padding of the saddle, to prevent compression of the pudendal nerve on the ischial tuberosity, and even clothing (breathable, hypoallergenic) are important to reduce the risk of ischiatic compression and saddle sores; finally, the position the wrist on the handlebars should avoid hyperextension compression and irritation of the nervous structures, particularly at the ulnar canal.

Riding a bike or ride on the cycle ergometer is a useful activity for fitness and health, even in people who can not run or walk, as it happens in diseases of the foot; the cycle ergometer implies less risk of injury compared to biking. In addition, with the subject sitting on the saddle, the weight-bearing joints and the lumbar spine are in partial discharge, and can work with a reduced risk of overloading. Bicycling is recommended in early osteoarthritis of the hip and knee; it is also recommended as an aerobic training in hypertension and in ischemic heart disease, diabetes, and it can be useful as a calory burning exercise to lose weight, especially for those who have difficulties walking or swimming. It is not particularly recommended for back pain and road cycling is not recommended for those who have balance, eye or ear problems; cross country cycling and mountain bike is not recommended to persons with poor health or unfit.

Each session must be accompanied by heating and cool-down. Compared to the cycle ergometer, the energy cots of cycling are more complex to calculate, as the type of terrain, slope and weather conditions may play a role; however, on average it can be said that the energy cost of cycling at the same average distance travelled amounts to 1/3-1/4 that of running; thus, to burn the same amount of calories, it is necessary to bike a 3-4 times greater distance compared to running. Generally, you start with three times a week; for the first sessions it is useful to ride at least 1500-3000 m; at a later stage, the same distance should be covered at a speed that will produce an increase in heart rate up to 40% MHR. In the subsequent sessions the distance should be progressively increased, increasing progressively training intensity (heart rate), frequency and duration of sessions. A distance of about 8-10 km in 45-60', 3 times a week is generally considerate an adequate schedule for maintaining training benefits in terms of fitness and as a preparation for more demanding programs.

V.3 Training strength and flexibility in the elderly

In very old persons (aged 80 or more), the main objective of training is to develop and maintain muscle strength needed for self-sufficiency. A thorough training is essential to learn the proper and safe exercises. Before training however, it is important to check risk factors (see the questionnaires, Chapter III), and to avoid exercise in the presence of any alarm bell.

For strength training the use of machines with programmable ROM is generally safer than free weights.

The training should include all major muscle groups (abdominal, often released and providing content to the viscera, back, chest, hip flexors and extensors). The effects of strength training is specific, being confined to the body part trained.

The strength and muscular endurance increase with exercise, following the principle of progressive overload, and the total volume of work for each muscle group is dependent on the load, the number of repetitions and of series within the session.

The initial charge can not be less than 30% 1RM and should gradually increase, it is generally not recommended to exceed 80% 1RM for the risk of musculoskeletal injuries. As with aerobic exercise, within the range of workout intensity, lower values would be effective and recommended for sedentary or unfit persons, while individuals who are already trained and fit should reach values in the highest stage of the spectrum.

Strength training is stimulated by increasing exercise intensity (external load), resistance training by increasing repetitions.

The recommended number of repetitions is 8-12, for a power exercise 6-8 repetitions with a higher load.

At least one series per session is recommended for every major muscle group, the set of muscles that help determine a specific movement in a specific articulation (for instance: flexor of the elbow); in fact, doubling the number of series the benefit is very small. This suggests that the quality (intensity) and not the total amount of work the most important factor for the development of strength in sedentary persons. Indeed, all studies conclude that for the first 3-4 months of strength training for elderly untrained persons, programs based on single series are as effective as multi-series programs. In addition, the time required to complete a program based on individual series is one and a half times less than that required for a multi-series program. It is also possible to combine muscle groups with exercises that engage more than one set, for example:-dorsal arms, shoulders, buttocks, thighs, chest, abdomen, legs.

The total duration of a session must be at least 20'-25 ', while the optimal frequency varies depending on the muscle group. Indeed, not all muscle groups in fact have the same optimal frequency of training: chest, arms and legs should be trained by 3 or more workouts per week, while lumbar and other small muscles of the trunk respond optimally to even lower frequencies (1-2 per week). The American College of Sports Medicine recommends a minimum of 2 times per week for all muscle groups, with at least 48 hours of rest between sessions. The recommended type of exercises is

dynamic, rhythmic, at slow to moderate speed, involving all the joint ROM, with particular attention during the eccentric contraction, which is associated with higher risk of injury.

The effects of strength conducted according to the ACSM recommendations are as follows:

- Increase in mass and muscle strength (on average 25-30% in 6 months - in very weak persons up to > 100%);
- Increased resistance to muscle fatigue (endurance);
- Increased muscle power, more if you exercise at high intensity;
- Increased bone strength;
- Increase in VO2max (much less than with aerobic workout);
- Improvement in glucose tolerance (to a lesser extent than aerobic workout).

The strength training is especially recommended in sarcopenia, the loss of muscle mass that occurs with aging, and in osteoporosis.

Since the suspension of training, maintenance of the effects is short: there is an initial loss within 1-2 weeks, which is completed within a few months.

For flexibility we mean the ability to perform large-scale movements within the limits of joint and muscle tendon, depending on individual elasticity and joint mobility.

The older you are, the longer it will take to develop the desired level of flexibility. The main reason we become less flexible aging is the result of some changes related mainly to a different degree of hydration and reduction of physical activity, things that both increase the rigidity of the connective tissue fibres. The other changes induced by aging that impact negatively on flexibility are represented by a larger amount of calcium deposits, and the replacement of muscle fibres with collagen fibres and adipocytes.

Stretching, the main mode of flexibility training, became popular from the States in Europe and Italy in the early 80s. The workout implies literally stretching the muscles through specific exercises, simple or complex. For several decades it has become part of any program of sports training, both for power sports and for endurance sports, before, during and after the performance.

Recently, however, some contradictory scientific evidence on stretching and dynamic ballistic exercises is emerging, especially concerning strength and power disciplines, while there is no negative feedback at the time on resistance, disciplines that require a considerable range of motion such as dance or martial arts. Some authors explain the negative effect of stretching on the performance of power (when it is executed before heating), attributing this phenomenon to the term "creeping" as so: during a year of extensive and prolonged stretching the muscle lengthens and this has the muscle fibres in alignment, although they usually have an oblique orientation and this accounts for the gain in elongation, but is accompanied by a decreased ability to store elastic energy.

According to Gummerson, flexibility (he uses the term mobility) is affected by internal and external factors.

Internal influences:

- Type of joint (some joints are not flexible)
- Internal resistance within a joint
- Bony structures which limit movement
- Elasticity of muscle tissue (muscle tissue marked from a previous injury is not very elastic)
- Elasticity of tendons and ligaments (ligaments do not stretch much and tendons should not stretch at all)
- Elasticity of the skin (skin actually has some degree of elasticity, but not much)
- Capacity of a muscle to relax and contract to meet the increased range of motion
- Temperature of the joint and associated tissues (joints and muscles offer better flexibility at body temperatures that are 1 to 2 degrees above normal).

External influences

- The temperature of the place where you train (a higher temperature contributes most to increase flexibility)
- The time of day (most people are more flexible in the afternoon than the morning, peaking from about 2:30 to 4 pm)
- The stage of the recovery process of a joint (or muscle) after injury (injured joints and muscles usually offer a lesser degree of flexibility than healthy ones)
- Age (before adolescence we are universally more flexible than as adults)
- Gender (females are generally more flexible than males)
- The individual capacity to perform a particular exercise (we learn by practice)
- Individual commitment to achieve the flexibility
- Restrictions on clothing or tools.

It is possible that the muscles of a joint to become too flexible; in this case the joint is given less support by the muscles around it, and too much flexibility can be detrimental as well as too little flexibility is not enough because both increase the risk of injury .

Once a muscle has reached its maximum length, trying to stretch the muscle further only stretches the ligaments and tendons providing excessive stress on them. The ligaments, if stretched more than 6% of their normal length, are torn; the tendons stretch only minimally and excessive stretching greatly increases their risk of injury.

The exercises for increasing flexibility represented by:

1. Active mobilizing exercises throughout the Range of Motion (ROM); these exercises should be slow and progressive;

2. PNF (Proprioceptive Neuromuscular Facilitation), a method of alternating isometric contraction drected againt the reisistance offered by the physiotherapist and stretching of the same muscle group; PNF is very effective, but requires a skilled operator to assist the person in the exercise. A modified technique called PNF can be performed alone or with a partner: expected contraction-relaxation exercises or stretching assisted (6''contractino against resistance, 30'' assisted stretching);

3. static stretching, easy to do and effective.

The ACSM recommendations for stretching advice a slow mode, a duration of 10''-30'' stretching the muscle group as far as to cause a slight discomfort (not pain!). The maximum gain in ROM can be obtained with 4 repetitions, then there is a plateau. All the major muscle-tendon groups (chain front and rear legs, shoulder girdle) must be stretched every training session, the minimum frequency of 2-3 sessions per week. The effects of stretching in accordance with the ACSM recommendations are as follows:

- Improvement of joint ROM and function;
- Improvement of muscular performance;
- Prevention of skeletal muscle type traumatic injuries.

As we have seen, the actual effectiveness of stretching before a session to improve the performance reviews is still controversial, while the long-term beneficial effect of stretching properly made with regard to flexibility and its impact on motor activity are not under question. The ACSM recommendations for physical activity to promote fitness in healthy elderly are given in Table II.V.

	AT	**ST**	**M**
Frequency Number of sessions per week	3-5	2	3-4
Intensity	55-80% MHR (=40-85%VO_2 max)	1 series, 8-12 repetitions for each of 8-10 main muscle groups; load: 30% 1RM - 80% 1RM	4 repetitions for all main maucle groups, stretch up to slight discomfort. (no pain)
Duration (minutes)	**20-60′**	**20-60′**	**5-15′**
Progression	Progressive increase of intensity and technical difficulty of the exercises		
Adjiustments	Progression of conditioning must e individualized		
Maintainance	If intensity is maintained and frequency or duration of sessions are decreased up to 2/3, VO_2 max is maintained up to 15 weeks and strength to 12 weeks		
Detraining	Deconditioning starts within 2 weeks from interrupting training and is completed by 10 weeks-8 months. Those who have trained for a long time seem to maintain benefits longer.		

Tab. II.V. AT = aerobic training; ST = strength training; M = Mobility/flexibility training.

V.4 Didactics technologies for the elderly: virtual environment role in balance training *Paola Aiello*

Recently, the importance ascribed by medicine, by the rehabilitation and psychological fields to all the tools which create virtual environments, make us consider the latter ones important aids to improve deficits in the elderly.

Technological literature distinguishes three kinds of VR: immersive, half-immersive and not-immersive, which can be carried out through many kinds of instruments having many different functions (Morganti & Riva, 2006).

Anyway, they all carry out, albeit in different ways, a new kind of man-computer interaction (Steuer 1992, Ellis 1996), involving not only the use of hands or of language but every single action of the person, which becomes a useful information for the Central Nervous System (CNS) which can remodulate, consciously or unconsciously, the action according to the received input.

The sensory-perceptive and motor involvement that takes place in virtual environments, makes the use of these technologies appropriate to the recovery, through training, of some functions affected by the aging. One of them that very often appears to be involved in the degenerative process, typical of the elderly, is the control of the balance making falls undesirable scenarios significantly affecting the individual's quality of life.

The control of the balance is the result of the integration of stimuli generated by the sensory organs like the view, the labyrinths of the inner ear and the sensory organs of the conscious and unconscious proprioceptive system and afferent to the central nervous system; it produces a motor response as a result of a complex process of rapid and selective integration.

"The visual cues provide information about the position and motion of the head with respect to the surrounding and based on information in the visual surrounding, a reference for verticality. The main role of the proprioceptive and somatosensory system is to provide a relationship between the body segments with respect to one another (limb position) and to sense the distributed tactile input stimuli at the neural level respectively. The vestibular system (located in the inner ear) keeps tabs on the motion and position of the head in space. It consists of otolithorgans, which detect the linear acceleration and gravity, and three semicircular canals, which detect the angular acceleration of head "(Virk et al., 2006).

How the nervous system takes cognitive decisions about the balance has been for long time an area of interest of neurophysiopathology that have helped to highlight how the deficit of the balance may be at the basis of peripheral lesions with impairment of sensory stimuli or central nervous system.

In the absence of one or more cues, or when the input from one of the sensors is skewed, the CNS "adapts" to the new environment and gives less weight to the conflicting inputs (Virk et al.,2006); if this process of adaptation of the CNS can be also observed in the presence of some specific focal cerebral and cerebellar disease conditions and in degenerative cortical or subcortical diseases that frequently involve

the CNS, in common degenerative processes that are typical of old age, (such as cortical atrophy, the myelin degeneration of chronic vascular ways with consequent degenerative changes of the connection fibers of white matter ...), the CNS ceases to be accurate. This is obviously worsened when there is also a disease process that affects the central nervous system and/or sensory organs.

Numerous studies have investigated the integration of sensory inputs on the process of adaptation implemented by the CNS ,verifying as well that in the absence of signals from the above mentioned systems, the CNS reformulate the weight and the integration of the available inputs.

In fact for effective balance control, it is necessary for the sensory inputs to work in a set of feedback loops so that, integration and feedback forms the key issues in any model that explains the strategies of CNS for balance.

To treat patients with deficit connected to degenerative processes that affect the correct functioning of the systems involved in balance, typical of ageing, researchers often suggest physical exercises, even if, not surprisingly, Virtual Reality (VR) is being evaluated for the recovery and training of the functions connected to balance (Virk, et al., 2006).

Various experiments have been performed with patients with a history of falls or exposed to the risk of falls. They have showed positive results about the effectiveness of the training using interactive, immersive and non-immersive, interfaces in CNS reweighting of the inputs and in giving less weight to the faulty or the conflicting inputs (Hayashi et al.,1998).

Older adults rely more on visual information to maintain their balance or to recover their balance even if there is a clear trend toward the reduction of head movements in elderly.

In this regard, some experimentation have shown that visual information that conflicts with the others arising from other sensory channels can have a rapid and profound effect on postural responses. (Vidal et al., 1982; Kreshner et al., 2004).

The influence of moving visual fields on postural stability seems to depend largely on the characteristics of the visual environments as well as from support surfaces, including the size of the base of support, its rigidity or compliance (Streepey et al., 2006).

A central recalibration process, within the limits imposed by the physiology of the organism, exists to produce appropriate responses even in the presence of sensory conflicts, i.e. when visual perception of the environment is discordant with proprioceptive information gathered from the support surface.

The decline in the integrity of many postural regulating systems, associated with ageing, may in fact be balanced by training strategies for the acquisition of selective sensory-motor of conflicting stimuli. Virtual reality providing conflicting stimuli as often they are realized in real contexts, in particular, appears to be a valuable teaching tool for training the capacity of the CNS of the elderly to select relevant information and resolve sensory conflicts that may undermine the postural stability.

A recent study has shown in fact that repeated exposure to contrasting stimuli through VR technology improves the ability of balance control in elderly subjects, through sensoty-motor integration with the constraints imposed by the environment and the ability to postural adaption.

It has been specifically elicited, through training in VR, cognitive processes ranging from correctly perceiving and interpreting information from different body sensors (somatosensory, vestibular and visual) planning and coordinating the effectors appropriately to produce the desired movement.

Learning new motor strategies or entraining them is, in this case, promoted in virtual environments from the changes in contextual stimuli, from alterations in the physical demands, problem solving, and random presentation of practice motor tasks demands imposed by the body, with consequent enpowerment of the involved subject (Winstein, 1991).

In this sense, the virtual reality for its reproducibility features of the real world provides an ideal environment to understand the strategies implemented by the CNS functional to maintain the balance using all the above mentioned techniques and making possible, in the meanwhile, the differentiation of the behavior of different sensory stimuli.

In these virtual environments, the simultaneous effects of various sensory modalities and the resulting associated or separated neural responses can be investigated and as evidenced by Keshner and colleagues, the postural responses can be evaluated through the deliberate manipulation of visual, vestibular and somatosensory stimuli.

International literature on this topic therefore suggests a possible use of virtual reality in the manipulation of feedback, particularly visual, to produce conflicts between visual, vestibular and somatosensory information thus acting as a mechanism of sensory-motor training of the different systems involved in balance control.

One of the principles that underpin the scientific *rationale* to support the efficacy of these technologies lies in the widely acknowledged role of the feedback in the control of movement and balance as well as of the repetition and motivation that are the key concepts of training programs and rehabilitation in the motor field. These elements appear to be deeply interrelated because the repetition of an executive pattern is necessarily accompanied with an increase in the success of actions that is registered by the central nervous system according to the information gathered from the senses (eg. vision, proprioception ....). The repetition, however, requires motivation that aims to make more bearable the extensive practice period.

In this regard, it is probable that the VR is a powerful tool for the development and the integration of all elements that are involved in the rehabilitation and training programs also aimed at the elderly. It can not be underestimated that the awareness of their deficit leads to a state of anxiety and / or depression that not only may cause a worsening of the deficit itself but may generate demotivation, slowing down the time of a possible recovery of vicariant and compensative functions.

In particular, in a virtual environment, feedback and / or knowledge of results which is acquired in real time following a trial, or block of trials, derives from the "*sense of presence*" that is realized when one has the feeling of being immersed in a real life situation, even if simulated, and the perceptual illusion of non mediation made by the technological medium (Lombard & Ditton, 1997). Interaction in VR generates, in particular, the plausibility of a causal relationship between perception and action to support what Gibson (1977) defines affordances that is a call to action on the basis of the acting opportunities offered by the reality; the "action" is controlled and planned in response to environmental conditions, needs, motivations and planned objectives.

It is therefore to identify a leading role to virtual reality in research, training and rehabilitation with, therefore, investigative, training and clinical functions also with regard to the difficulties and diseases that affect the quality of life of elderly individuals.

As heuristic tools, the successful integration of virtual reality into multiple aspects of medicine, psychology, and rehabilitation has demonstrated the potential for the technology to present opportunities to conduct safe, ecologically valid experimentations while maintaining experimental control over stimulus delivery and measure-ment through a deliberate manipulation of the variables that are assumed to be involved in the examined processes.

In the field of rehabilitation and training, these tools help to standardize the measurements, individualize treatment or training protocol, graduating, documenting, and above all creating motivating contexts and situations in which the elderly can recover through the success of her/his own actions and the gradual improvements, the self-efficacy and the internal locus of control undermined by aging.

V.5 The educational use of stabilometric platforms for the realization of physical activity for the elderly

Stefano Di Tore

The technological progress and the general improvement of the social conditions, together with the new discoveries of the medical science, lead to a general increase of the average age of life, especially in the Western Countries.

Hence, the main issue about the improvement of the lifestyle in the elderly is becoming more and more important in every field, from psychology to medicine, from sociology to the motor science, etc.

Therefore, how to help older persons in saving their independence is becoming a great issue both from a social and a medical point of view.

In view of this, the analysis of posture has certainly an important role, since it can help to prevent troubles of balance, falls and, generally, other pathologies linked to the balance which can lead to the loss of one's own motor abilities and of the independence of the elderly.

The word "posture" is generally used in the medical and motor science fields to indicate the position of the body in the space and in relation to the outer world. The science which studies it is called Posturology. It studies the causes of the troubles of

balance responsible for many diseases affecting the musculoskeletal system, such as scoliosis, spinal pains, balance disorder, etc.

To achieve this goal the Posturology uses tests to measure specific factors useful to understand and study the posture of the subjects.

The Stabilometry is one of these factors and it is particularly important for this article. It is a test that can evaluate and measure the balance, through precise instruments that meet international standards of construction, sensitivity and calibration.

Before introducing the practical clinical applications of this analysis, it is useful to illustrate what systems are responsible for the postural attitude, how the bioengineering tools at our disposal work and how they consider the phenomenon of posture from a biomechanical point of view.

All this in order to better understand the level of reliability of this analysis and how the data, provided by the technologies discussed herein, can be interpreted.

It is also worth noting that in this article we will discuss only the possible applications of the analysis of quiet stance taken through force platforms.

The postural system

The upright position, typical of the human race, is maintained through continual adjustments of the posture of the body, carried through a continuous stabilization process implemented by muscles and osteoarticular system. The upright posture implies continuous postural adjustments to compensate for strength, both internal and external, which modifies the balance of the subject. The body, left to itself, would be inevitably destined to collapse to the ground, yet this does not happen. This is due to the fact that the human body has got a system which can set its own balance finely and effectively.

To describe the stability of the upright posture of the human body, it is useful to point out that the projection of the body gravity vector generally stands inside a surface smaller than a cm^2, an area smaller than 1% of the base of support that is available and compatible with the upright balance.

Therefore the body can assure a wide margin of safety to maintain its upright posture. The loss of the balance naturally causes falls which, on their turn, may cause serious injuries; so here's the importance of a system that preserves and maintains the balance.

The range of parameters, which allows this system to maintain an upright posture without collapsing to the ground, is a study on which particularly focuses the scientific interest. They search and analyse the standards that allow to note the warning signs of the normal antigravity function, even in small changes of the posture, and the standards which allow prevention and suitable treatments for a correct posture.

The analysis of the process and the factors which determines the upright posture is called posturography. It observes and measures the occurred stabilization against gravity and any disruptive agents, whether internal or external to the body.

The balance

The maintenance of the upright posture and the balance in human beings is mainly the result of a continuous cooperation of three systems:

- The sensory system
- The central nervous system
- The muscle and bones-joints actuators

Any change of one or more of these systems may cause the loss of a postural stability.

The human being can control the motor responses through the activity of his brain in order to maintain the balance and avoid dangerous falls. The brain interprets and integrates the information from the senses during the continuous changes of the posture due to the movement.

Even the cerebellum plays an important role in the regulation of movements, especially with regard to the synergy between agonist and antagonist muscles.

In the elderly, the balance gradually deteriorates, and this influences the gait that worsens considerably (shuffled, uncertain, arrhythmic steps, etc). The deterioration of the balance in older people is mainly due to senile deterioration of the sense organs and the locomotor system.

The causes, which can arouse a change of the balance in the elderly, can be summed as follows:

1. Decrease of the speed of the rapid postural reflexes or alteration of the efficiency of nerve antigravity pathways.
2. Osteoarticular diseases
3. Cardiovascular diseases
4. Cerebrovascular diseases
5. Neurological diseases
6. Taking drugs that interfere with nerve reflectivity
7. Diseases of the labyrinth
8. Visual disorders
9. Hormonal Disorders
10. Anemia
11. Infectious diseases

Specific tools, as the force platform, can provide objective measurements of the change of some factors which are essential to preserve the balance, as the wideness of the COP oscillation, or the pressure distribution.

Before introducing the possible uses of this analysis, it is useful to show some important concepts underlying the functioning of the technologies on which it is based.

The functioning factors of the postural system from a mechanical point of view.

To better understand the functioning of the technologies which allow this kind of analysis it is necessary first to understand the mechanical process that regulates the maintenance of the upright posture, and to this end, it is necessary to introduce some important factors.

Although there are studies on the movements that each part of the body makes to allow the body to maintain an upright posture, such as the studies on the movements of the head and those on the relationship between the movements of the trunk and head, usually, in practice, only fluctuations in the body's center of gravity are examined, assuming that "the primary purpose of a control strategy of an upright posture is to keep the center of gravity within the perimeter of support, within an area small enough to ensure some margin of safety."

Hence, the following two variables become essential:

- *The center of mass* (**COM**), i.e. the centroid of the body segments that make up the body, "whose position determines the lever arm of the force of gravity compared to the joints and the sign of the corresponding destabilizing moment".
- *The center of pressure* (**COP**), i.e. the centroid of the pressures applied on each point of the surface of the foot in contact with the ground.

It is the application point of the resultant of the forces exchanged between the foot and the ground (ground reaction force), whose position determines the lever arm of the external force of reaction as to the joints and the sign of the corresponding reagent time.

In other words, the COP is the center of gravity of the ground reaction forces applied on each point of the surface of the foot in contact with the base.

To sum up, we can state that the COM, reflecting the real movements of the body segments, and the COP, reflecting the action of the muscular forces, are the two key variables of the postural control.

The biomechanical model, which is applied to the analysis of an upright posture at rest, can indeed be illustrated with a simple inverted pendulum hinged at the ankle, with a single degree of freedom in the sagittal level.

Inside this model, the COM, the COP and their relationships are the main factors to analyse.

Tools and Technologies

With regard to the experimental analysis of the postural control, there are many tools that the bioengineering proposed. Anyway, the force platforms are the first group of technologies that imposed itself in this kind of analysis.

Generally, the only external forces studied with regard to the posture are those due to the gravity.

The tools which study these kinds of forces are those based on Newton's Law, which states that for every action there is always an equal and opposite reaction. During the evaluation of the posture of a person at rest, the body exerts a force on the ground and the ground reacts with a force of equal intensity but opposite direction. Noting the force with which the soil responds, it is therefore possible to calculate the force applied on it by the body.

On this principle it is based the functioning of the instruments for the analysis of the external forces acting on the body, such as the force platforms, which are the key factors for an analysis of the posture.

The force platforms allow to record some important aspects of a posture at rest. Generally, they have sensors which survey the pressure, rejecting the third dimension, which is not particularly important in this case, and reducing the analysis of the posture to a bidimensional problem.

Traditionally, the two coordinates of the COP (middle-lateral, anterior-posterior) are the parameters which are detected and studied. Almost all the other indicators used to study the posture through the force platforms can be traced back to these two parameters.

The detection of the coordinates of the COP over the time allows the analysis of the time trend of its position, which can be done through two types of representation

standardized by the International Society of Posturography: the Statokinesigram (or Ball) and the Stabilometry.

- The Statokinesigram is the bidimensional layout of the path of the center of pressure on an horizontal support surface.
- The Stabilometry is the graph of the coordinates of the center of pressure over the time.

These indicators allow to visualize and to quantify the instant speeds of the COP, i.e. the frequency of the oscillations.

The area of confidence is another parameter that is often studied.

The confidence ellipse is defined as the ellipse that, with the 95% of probability, contains the center of the points of the sway. The surface of the confidence ellipse is expressed in mm^2, it allows to calculate the wideness of the sway and thus to highlight the patient's energy expenditure to maintain an orthostatic position. In a normal situation it is less than 1 cm^2, anyway the posture is highly subjective and, therefore, the only area of the ellipse cannot prove the existence of any disease.

The length of the ball and the average speed are not important measure to calculate the patient's energy expenditure.

With regard to the COM, there have been proposed many models of evaluation based only on data got from the force platforms. They range from the application of filters to eliminate high frequencies (lowpass-filter) of the COP, to eliminate the rapid oscillations of the same, to the integration of horizontal elements of the reaction force. However, none of these methods provides an accurate analysis of the COM and the mathematical models to calculate it only through the force platforms are still under development and validation.

For these reasons the study of the COM, although this is an essential parameter for a thorough examination of posture, did not spread very far in this kind of analysis, and numerous models deal with the problem through the assimilation of the COM projection on the ground with the position of the COP.

Clinical Applicactions

The risk of falling increases dramatically as far as the age raises, so that almost a third of people whose age is more than 65 years lives the unpleasant experience of falling once a year.

Of course, the posture and the equilibrium can be influenced by several factors and the analysis of the changes of the COP and the COM can be related to different diseases.

Currently, many studies in the clinical field are using the techniques of the static posturography and force platforms to analyze the effect of the aging on the postural control and on the balance.

Era and Haeikkinen made a study which seems to prove that the postural sways stay within certain established parameters till the age of 30, then they progressively increase with the age.

Instead, other studies are intended to identify in the oscillations a clear predictive sign of the increase of the risk of falling in the elderly.

Nowadays the main applications of the surveys conducted through force platforms in the clinical and the rehabilitation fields cover illnesses such as diabetes, Parkinson's

disease, deficits related to sight and hearing and many other diseases that can affect the normal maintenance of the postural equilibrium.

The diabetic foot, for example, has an uneven distribution of pressure, and this contributes to create serious problems such as foot ulceration.

An analysis of the distribution of the pressure on people with such diseases is particularly useful for the production of footwear designed to balance the abnormal distribution of pressure and so avoid serious consequences.

Other studies have focused on the pharmacological and surgical treatments in relation to postural oscillations.

Particularly, in the case of patients with Parkinson's disease, postural changes were noted after several treatments, such as levodopa (DOPA) and electrical stimulation of the basal ganglia.

The COP area, which is larger than the mean in people with Parkinson's disease who did not have undergone treatments, increased further after the administration of levodopa, while the electrical stimulation of the basal ganglia seems to produce a stabilizing effect on posture, bringing the area of the COP to the average levels.

Other studies of the implications and changes in postural balance have been done on elderly subjects in relation to the physiological conditions of the visual apparatus such as presbyopia, myopia, and in general all the pathologies that involve a decrease of the sight.

These studies have shown that the changes of the balance due to the age and to the sight lead to strategies to control the step while walking.

However, the results of these studies have also shown that these natural strategies to balance the body while walking reduce the instability but do not increase the safety margins of walking.

It seems clear that a careful analysis of these factors could help to prevent the deterioration of the balance in the elderly through appropriate remedial training means or through physical activities specifically designed for the type of deficit of the subject.

The analysis of the static posture, made only through force platforms, provides important clues about maintaining the balance of a subject.

As shown, a careful exam of the posture would require a careful analysis of even the COM, which often cannot be detected, unless loosely, through the only force platforms.

Despite this lack, the COP sways and the standard parameters provided by this type of tools may help to understand the posture of patients and provide a valuable aid to plan effective remedies.

The balance may in fact be re-educated or trained with exercises specifically studied and carefully graded according to the difficulties. These could be aimed at restoring, as far as possible, the values of the COP within the mean, or they could be directed at increasing the safety margins necessary to maintain an upright posture.

In this way, it would be possible to decrease the risk of falls in older people thus avoiding the attendant risks, such as loss of their own motor skills.

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.

CHAPTER VII

PHYSICAL ACTIVITY AND DIABETES MELLITUS IN THE ELDERLY

Raffaello Molino Lova - Claudio Macchi

VII.1 Aging and diabetes mellitus

Diabetes mellitus is characterized by a pathological increase in the concentration of glucose in the blood. This is due to a relative or absolute lack of insulin or a deficit or total absence of insulin at the tissue. Insulin is a hormone produced and secreted by pancreatic beta cells and is essential for the metabolism of sugars.
Values of glycemia before meals are considered normal to 110 mg / dl; values between 111 and 125 mg / dl define the condition of impaired glycemia before meals; values equal or higher than 126 mg / dl of glycemia before meals define the condition of diabetes mellitus.

There are three main types of diabetes:

1. Type 1 diabetes;
2. Type 2 diabetes;
3. Diabetes in pregnancy.

In 1985 people with diabetes, without distinction of type, were 30 million; in 1995 they were 135 million; in 2001 they were approximately 177 million; in 2030 about 370 million people are supposed to suffer from diabete[1].

Diabetes mellitus type 1 is a multifactorial and polygenic pathology characterized by specific and selective autoimmune destruction of pancreatic beta-cells.

The prevalence of this type of diabetes in Italy seams to be between 0.1 and 0.3%; the incidence is between 6 and 10 cases per 100,000 per year in the age groups from 0 to 14 years, while it is estimated in 6.7 cases per 100,000 per year in the age groups from 15 to 19 years [2].

Diabetes mellitus type 2 is not characterized by an absolute insulin deficiency, but by a relative deficit and a resistance to the action of insulin for a reduced response of the tissues. It is the result of a complex interaction between the genetic profile of the individual and many enviromental factors [3].

Endocrine-metabolic disorder is the most widespread in the world, affecting 5-10% of the population in industrialized countries and representing 90% of all forms of diabetes. It is estimated that over the next 10 years, patients with this type of diabetes in the world will be about 220 milions[4].

The reasons for this increase are to be found in the profound changes in lifestyle which has occurred in recent decades: high-fat diet and low in fiber, physical inactivity and obesity.

The symptoms are represented by polyuria, polydipsia, drowsiness. The complications are the macroangiopathy (involvement of coronary, supra-aortic trunks, abdominal aorta and leg arteries), microangiopathy (renal and retinal involvement)

and neuropathy.The pancreas is a gland mixed in secretion, endocrine (internal secretion) and exogenous (external secretion).

Endocrine function is linked to the production by the islets of Langerhans of four hormones:

1) insulin (beta cells);
2) glucagon (alpha cells);
3) somatostatin (delta cells);
4) pancreatic polypeptide (F cells).

Insulin and glucagon have opposite action:

- The first is anabolic, it increases the reserves of glucose, fatty acids and amino acids;
- The second is catabolic, mobilizing glucose, fatty acids and amino acids from storage and putting them in a circle.

Insulin reduces the concentration of glucose in the blood by inhibiting production in the liver (glycogenolysis and / or gluconeogenesis), facilitating the recruitment and metabolism of glucose in muscle and adipose tissue; it determines the entry of the glucose in the cells and selectively accelerates the entry of that portion of glucose that enters in cells by simple concentration gradient directed inward, at the level of adipocytes inhibits the hydrolysis of stored triglycerides; it stimulates furthermore the protein metabolism by inhibiting protein degradation of muscle proteins.
The lack of insulin causes hyperglycemia as well as increased gluconeogenesis and ketone bodies.
Too much insulin causes hypoglycemia leading to coma, an excess of glucagon causes hyperglycemia.

The table below (Tab.IV) describes the factors that influence the secretion of insulin.

Factors stimulating the secretion	**Factors inhibiting the secretion**
Glucose	Somatostatin
Amino Acids	Insulin
Glucagon	Adrenaline and noradrenaline
Acetylcholine	Hypokalaemia
Intestinal hormones (CCK, GIP, secretin, gastrin)	Drugs: beta blockers, thiazide diuretics
Drugs: beta stimulants, theophylline	

Table I.V

It seems that with age the reduction of hormone production (except for changes caused by menopause) is partly attributable to vascular or degenerative diseases of the neuroendocrine ways of the hypothalamus and the suprachiasmatic nucleus.

The limitation of hormone production is of fundamental importance in physical activity, especially in intense physical activity.

In fact hormones regulate:

- the volumes of the circulating liquid;
- cardiovascular performance in hot environments;
- mobilization of "energetic" substances necessary to repair the body structures by the synthesis of new proteins.

The evidences on the subject are contrasting . There is agreement on reduced insulin secretion, the response delay in its secretion, the decrease in insulin sensitivity (resistance) in the tissues and its reduction in the rate of elimination.

Approximately 20% of men and 30% of women that are 70 years old show abnormal glucose tolerance curves for the most part due to reduced insulin tolerance (for decrease in peripheral insulin sensitivity predominantly at post-receptor level).

The decrease in physical activity, the reduction of body mass for the storage of glycogen, the increase in adiposity and a reduced amount of Chromium in diet may contribute to increase reduced insulin tolerance.

There has also been an increase in sympathetic nerve activity, the slow blood clearance of insulin and the reduction of pancreatic beta-cell response to stimulating and inhibiting hormones. The levels of glucagon are poorly altered in the elderly.

VII.2 Physical activity, exercise and diabetes: didactics guidelines

Normally, the exercise leads firstly to the use of muscle glycogen with release of glucose; once depleted the reserves of glycogen, blood glucose (from the liver glycogen) and fatty acids are used, subsequently the glucose produced in the liver through the gluconogenesi (the use of amino acids, lactate and glycerol) is utilized.

Glucose production is adequate to supply-demand balance and muscle uptake. In the case of high stress the muscle uses glucose cytoplasmic, in moderate stress the use of fatty acids prevails (released from adipose tissue for the decrease of insulin levels and the increase of concentrations of catecholamines).

In the case of intense physical activity energy production by the liver is regulated by catecholamines, whose concentration increases up to 15-20 times. Physical activity increases glucose uptake by muscle independently of insulin (increased amount of transporter proteins).

In diabetic person there are numerous endocrine adaptations, mainly a marked adrenergic stimulation with downward trend of plasma insulin and an increase of catecholamines, cortisol, and glucagon.

The incidence of diabetes is higher in those who do not practice regular physical activity.

It has been demonstrated the effectiveness of the diet (healthy in subjects of normal weight and able to induce a loss of 1 kg per month in the obese) and physical exercise (30 minutes a day of walking or 20 minutes of fast walking or 10 minutes of running) in reducing the onset of new cases of diabetes.

There has been a reduction in the incidence of type 2 diabetes by 31% with diet alone and 46% with exercise. Thereby, improving the lifestyle, including an aerobic exercise of moderate intensity and body weight loss of 5%, may be reduced the incidence of diabetes mellitus type 2.

Intensive lifestyle changing can delay the incidence up to 58% [5,6,7,8].

Cohort studies have confirmed that ongoing and high level physical activity is associated with a significant reduction in cardiovascular and general mortality [3, 5].

In type 2 diabetes, physical exercise against resistance, associated with weight loss, is effective in improving glycemic control and some parameters of metabolic syndrome as well as in preventing the loss of muscle mass. So, mixed programs of aerobic exercise and against resistance give an additional benefit to glycemic control, avoiding some risk factors [9,10,12,13,14,15].

The social and psychological factors have a great impact on physical activity. It is documented that, younger age, a high cultural level, the absence of motivational barriers, a high degree of perceived health and performance expectations, correlate with the degree of practiced physical activity [16].

Physical activity counteracts the insulin resistance that can be observed in inactivity and insulinemia is reduced at the same blood glucose levels. The exercise also induces insulin affinity changes in skeletal muscle receptors and in the amount of glucose and amino acids taken from the cell (cytoplasmic metabolic disorders).

In not controlled type 2 diabetes, physical exercise produces a further rise in blood sugar, fatty acid and ketone bodies in plasma (gluconeogenesis, glycogenolysis, decreased glucose utilization).

When it is controlled by appropriate insulin therapy, physical exercise usually provokes hypoglycemia and hyperinsulinemia (increased insulin action at the tissue, acceleration of the insulin absorption), which may require the intake of carbohydrates or reduction of insulin dose.

In type 2 diabetes aerobic physical exercise of moderate intensity reduces blood sugar levels (increased glucose transport across the cell membrane and increased insulin sensitivity), often accompanied by a reduction of the associated obesity.

In the elderly, of course, grade and extent of the effort, for the same activity, are different: for example, the same effort that provokes in a 50 years old person a consumption of 420Kcal / h (7 MET) in a 80 years old person can mean the use of 180 Kcal / h (3 METs).

Before starting a physical activity of intensity higher than a fast walk is necessary to exclude conditions of high cardiovascular risk (in particular, uncontrolled hypertension) and the presence of complications that contraindicate the practice of certain exercises for the high risk of evolution of the disease (severe vegetative

neuropathy, severe peripheral neuropathy, retinopathy, pre-proliferative or proliferative and macular edema).

For the adult and elderly diabetic person in good metabolic balance (with proper insulin dose if suffered from diabetes type I °) there are not contraindications to physical activity, but before starting any type of activity should be diagnostically excluded the frequent neurological and cardiovascular implications [17].

In this regard, the following controls are recommended:

- resting ECG and exercise ECG (or ECO-stress test or myocardial perfusion to dipyridamole);
- study of the retina (proliferative retinopathy predisposes to retinal hemorrhages under stress);
- cardiac and of supra-aortic trucks echocolordoppler;
- arterial doppler of the lower limbs;
- blood sugar split before, during and after physical activity at the beginning of the program (to avoid dangerous hypoglycemia), possibly by changing diet and insulin dosage or oral agents (in patients who use it);
- assessment of the sensitivity (neuropathy, and thereby reduce sensitivity to pain, may lead to lately recognize skin lesions);

It is important that the subject brings with him/herself a supply of carbohydrates (preferably high in fructose sweets which keep the blood sugar levels more constant compared to glucose).

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GLOSSARY

A-

Abasia: is the inability to walk

Above bulbar or pseudo bulbar syndrome: neurological syndrome characterized by impairment of phonation (nasal tone of voice), swallowing (dysphagia), and gait.

Absolute risk: incidence of a disease among individuals exposed to a particular risk factor

Abulia: refers to a lack of will or initiative

Accelleration: vector quantity that identifies the changes in speed per unit time. A centrifugal tendency of a body to move toward the exterior of a curvilinear path. A centripetal (ac) vector quantity that expresses the changes in angular velocity.

Acclimatization: it is the process of an individual organism adjusting to a new and hard to bear situation as the acclimatization to high altitude and in stressful conditions, heat, cold, low oxygen pressure and drought.

Ace: angiotensin converting enzyme

Acetylcholine: ester of choline. Chemical mediator of the transmission of the nerve impulses at the neuromuscular junction and of the parasympathetic autonomic nervous system. It strengthens the contractions of the digestive tract, causing bronchoconstriction, capillary and arterial vasodilation, bradycardia.

Acidosis: is a physiological condition characterized by low pH in body tissues and blood and increase in H + ions.

Acne: pilosebaceous unit inflammation.

Acro asphyxia: cyanosis with painful anesthesia of the extremities.

Acro cyanosis: cyanosis of the extremities more rarely of the ears, nose and cheekbone.

Acromegaly: abnormal enlargement of the facial bones and of the extremities due to pituitary dysfunction.

Acromelalgia: paroxysmal pain, often at night, of the limbs. It is frequent in obstructive arterial disease.

Acroparesthesias: syndrome characterized by, tingling, numbness at night, pain mainly of the upper limbs.

ACSM: American College of Sports Medicine

Actin: contractile protein present in all striated muscles.

Actomyosin: complex formed by the combination of actin and myosin.

ADA: American Diabetes Association

Adenoma: benign epithelial tumor in which cells form recognizable glandular structures or are derived from a glandular epithelium.

Adenosindifosfato (ADP): see adenosine triphosphate.

Adenosine triphosphate (ATP): a substance that quickly gives way to two molecules of phosphoric acid / phosphate (ADP becoming adenosindifosfato adenosinmonofosfato amp), and thus give chemical energy necessary for most assets.

Adenosinmonofosfato (amp): see adenosine triphosphate.

ADL (Activities of Daily Living): evaluation of the normal activities characterizing the functional status of the elderly related to their need of help in walking, getting out of bed and going to bed, bathing, dressing, eating, carrying out normal physiological functions..

Adrenaline: a hormone secreted by the adrenal medulla and sympathetic ganglia, producing tachycardia, vasodilation, hypotension, bronchodilation, mydriasis, sweating, hyperglycemia

Afterload: load that is encountered when the muscle begins to contract. It directly relates to peripheral resistance

Agnosia: inability to recognize objects, persons, sounds, shapes, or smells.

Akinesia: is the inability to initiate movement.

Aldosterone: hormone of the adrenal cortex. It causes reabsorption of sodium and potassium elimination, which consequent increase of the LEC and hypertension.

Alkalosis: a condition characterized by a decrease in the concentration of ions h and increase in pH.

Allergy: hypersensitivity reaction of the body to various immune substances.

Alpha fibers: nerve fibers that supply extrafusal muscle fibers with agonist and antagonist functions

Alpha-1 antitrypsin: a substance capable of antagonizing the action of trypsin.

ALS: amyotrophic lateral sclerosis. Degenerative disease of the 1st and 2nd motor neuron, there was a high prevalence in some subjects practicing sports at a competitive level

Amaurosis fugax: temporary loss of vision usually from one of the two eyes.

Amaurosis: blindness.

Amnesia: memory loss

Amyloidosis: a type of cell degeneration with accumulation of amyloid in various organs.

Analgesic : pharmaceutical drug used to relieve pain.

Anamnesis: collection of information regarding family history, physiology and pathology of the patient.

Ankylosis: welding of articular with complete fixation and immobility of the joint.

Anaphylaxis: generalized hypersensitivity reaction of the body to external substances of various

Anemia: reduction of the amount of hemoglobin in the blood.

Aneurysm: expansion of the arterial wall accompanied by alteration of the elastic and muscular constituent.

Angiectases: A generic term indicating dilation of a vessel.

Angina pectoris: syndrome characterized by violent painful chest crises mainly retro-sternal usually associated with coronary artery disease; unstable when more prolonged and frequent, at rest or with minimal effort, it often precedes a heart attack; variant or of Prinzmetal linked to coronary spasm, almost exclusively at rest

Angiography: X-ray of a vessel after intravenously or via arterial (using a catheter) injection of a radiopaque (usually iodine substance).

Angioma: benign tumor or congenital proliferation of neo-formed vessels.

Angioplasty: dilatation of a stenosed vessel with a balloon catheter. It often precedes the application of stents.

Angiotensin: decapeptide transformed, by the action of renin, angiotensin II, potent vasoconstrictor.

Angiotensinogen: plasma globulin from the liver which releases angiotensin I, after the action of renin.

Anosognosia: inability or refusal to recognize a neurological deficit such as hemiplegia.

Anorexia: eating disorder that is charcterized by an absolute refusal of food.

Anosmia: absent or reduced sense of smell

Anoxia: a lack of oxygen.

Antiphlogistic**:** synonymous with anti-inflammatory.

Aortic insufficiency: oppositional resistance to aortic flow.

Aphasia: lack or loss of ability of expression with words and writing, which is accompanied by a deficit of understanding.

Aphonia: loss of voice due to the default of sound apparatus (mainly due to disruption of the recurrent laryngeal nerve)

Ataxia: disease characterized by incoordination of muscle movements.

Atrium: the left and right, blood pumping at low pressure in the respective cardiac ventricles.

Astasia: inability to stand up.

Atrial fibrillation (AF): fibrillar activation of muscle fibers of the atria that causes rapid contractions (300-500 min) in an irregular and disorganized way as not to be able to produce systole. As it no longer exists as a sinus rhythm and the AV node discharges irregularly, the ventricles contract with an irregular, higher than normal frequency, (no rhythm). It is usually linked to atrial enlargement that provokes the formation of thrombi at the atrial level with possible embolic events.

Atrial flutter: ectopic atrial activity usually set at high frequency (250-350/min). Ventricular contraction usually has a regularfrequence because it is associated an atrioventricular block.

Atrophy: decrease of the size of a cell, tissue or organ.

Attributable risk: the difference between the frequency of incidence of a disease among exposed individuals to a risk factor and not exposed ones.

Autoimmunity: a condition characterized by a specific humoral immune response or cell-mediated immunity against the constituents of their body tissues.

AV block (BAV): atrioventricular heart block. It may be I, II and III degree AV block.

B-

Balance: status of a body in balance. The balance is called "static" when the body is at rest, and without motion. The balance is called "dynamic" when the body moves with uniform motion, ie at constant speed.

Beri-beri: disease characterized by a lack of vitamin B1 or thiamine.

Beta-adrenergic receptor ()**:** receptor sensitive to adrenaline. It is divided into beta1 (lipolytic and cardiostimulants) and beta2 (bronchus and vasodilators).

Beta-blocker: a substance that inhibits the effects of beta-adrenergic catecholamine receptors. They mainly cause brady cardia and reduction in blood pressure.

Bigeminy: the presence of a premature beat (extrasystole), ventricular or supraventricular, after each complex of the basic rhythm.

Biofeedback: a set of procedures for volunteer feedback control of normally involuntary physiological processes, created by electronic devices.

Blood pressure: the resistance of the arterial wall to blood pressure.

blood volume: total blood volume in the bloodstream.

Borg scale b.: scale assessing the subjective perception of stress in relation to its intensity..

Bradycardia: slow heart rate below 50 bpm.

Bruising: stain on the skin due to extravasation of blood from the vessels to tissue.

Bulimia: a condition characterized by a pathological increase of hunger also after ingestion of large amounts of food

Bundle branch block: see Rbb and Lbb.

Bypass: surgical procedure. It connects upstream and downstream segment of n clogged artery

C-

Cachexia: a condition of extreme decay characterized by strong physical weight loss.

Calorie (small calorie or symbol cal)**:** unit of energy; it is defined as the amount of heat required to raise from 14.5 to 15.5 ° C the temperature of the mass of one gram of distilled water at the level of Sea (pressure of 1 atm). In biology, or nutrition, large calorie (cal or kcal), equivalent to 1000 cal, is used to indicate the energy content of food. The determination of calorie intake should be made in reference to sugar (glucose), which is the natural food for easier assimilation, taking into account that a spread 3.92 kcal g sugar, one gram of protein and about 4 calories a gram of fat approximately 9 calories, all other foods must be related to them in order to calculate energy intake. The international system of units includes the use of joules instead of calories (kilojoules and instead of the large calorie).

Calorimetry: measurement of the heat produced by a living organism in a small closed room (direct); It calculates it from their consumption of oxygen and from the carbon dioxide and nitrogen (indirect).

Cancer: relating to neoplasia, cancer.

Capillaroscopy: microscopic examination of blood capillaries in the living subject.

Carbon dioxide: the most important gaseous product of the metabolism (and of the burning). It is the gas that dissolved in water, gives rise to carbonic acid (weak acid); it is a metabolic product that most directly controls the power of breathing.

Carboxyhemoglobin: hemoglobin combined with carbon monoxide, which occupies the sites that bind oxygen. The reaction is poorly reversible.

Cardiac tamponade: cardiac compression due to pericardial effusion with cardiac output to fall obstacle to ventricular filling.

Cardiomegaly: increase in heart size.

Cardiomyopathy: heart muscle disease, often of unknown cause. It may be distinguished in dilated, hypertrophic, obstructive, restrictive and obliterative cardiomyopathy.

Caregiver: English word that defines the person who takes care of another person.

Cartesian coordinates: conventional reference system used to describe the course relative to changes in position of a body on a plane or space.

Catalase: enzyme of the class of oxidoreductase that transforms 1 + 1 molecules of hydrogen peroxide in 1 molecule of o_2 and 2 of water.

Cataracts: eye condition characterized by opacity of the lens.

Catecholamines: substances with sympathetic activity, consisting of catechol + amine, as the adrenaline (epinefina), the noradrenaline (norepinephrine) and the dopamine.

Catheterization: Introduction of a catheter into a vessel or a cardiac cavity for diagnostic or therapeutic purposes.

CCK: cholecystokinin.

CCK: cholecystokinin. 33 amino acid polypeptide hormone, secreted by the mucosa of the upper intestine and hypothalamus; it stimulates gallbladder contraction and secretion of pancreatic enzymes. It is synonymous with pancreozymin.

Cellulose: carbohydrate, long-chain of polymer of glucose which is the backbone of many plant structures.

Center of gravity or center of mass: point of a body which acts on the resultant of the forces of gravity.

Chlamydia pneumonia: a genus of bacteria of the family of chlamydiaceae. It consists of Gram-negative, coccoid, which only multiply inside the host cell and have a unique growth cycle.

Cholangitis: inflammation of the bile.

Cholecystitis: inflammation of the gallbladder.

Cholinergic receptor ()**:** molecule with mail function on the cell surface receptor that binds the neurotransmitter acetilconlina mediating its action on the post-junctional cells.

Chondrocyte: mature cartilage cells housed within a gap in the cartilage matrix.

Congestion: accumulation of blood in an organ due to the expansion of the lumen of its blood vessels.

Chromaffin cells: cells that absorb and which stain strongly with chromium salts, which are found in the adrenal glands, coccygeal and carotid arteries along the sympathetic nerves and in various other organs.

Chronotropic: the frequency of a rhythm.

Clearance: speed with which a substance is removed from blood or other body. **Clonus:** contraction and relaxation of muscles alternating in quick succession.

Clot: mass of clotted blood in vitro, outside the body.

CNS: central nervous system.

Co-Contraction : simultaneous (synergistic) contraction of agonists and antagonists muscle for the purpose, primarily, of the setting of a body segment.

Collapse or shock: condition of varied etiology characterized by inadequacy of the cardiovascular system to ensure an adequate blood supply to tissues and elimination of waste. It is characterized by reduction in cardiac output, tachycardia, hypotension and decreased urine output.

Collapse: failure of the walls of an organ.

Compliance: distensibility, the ability to yield to pressure.

Congestive heart failure: a condition due mainly to a deficiency of the ventricular pump. It is characterized by dyspnea, venous stasis and edema (pulmonary and lower limbs).

Contracture: sustained contraction due to lack of relaxation in the absence of action potentials (inhibition of calcium transport).

COPD: chronic obstructive bronchopathy.

Core: the middle of something.

Couple of forces: system of two parallel vectors, of equal and opposite form, applied to a body whose action tends to rotate.

Creatinine: a substance produced by muscles and excreted by the kidneys in urine; its amount in the blood increases when the kidney is not working properly.

Crohn's disease: chronic granulomatous inflammatory disease of the gastrointestinaltract.

Crohn's disease: inflammatory bowel disease that tends to recur periodically.

Csa: cross sectional area or section of the muscle.

CT: computed tomography, diagnostic procedure based on the use of x-ray that allows the reconstruction of sections of a body area

Cubital angle: external angle formed by the arm and forearm extended at the elbow. Normal value = 168 °.

Cushing: Cushing's syndrome is secondary to hyperfunction of the adrenal cortex, characterized by hypertension, striae rubra (reddish stretch marks), collected fat in the neck and face, increased blood sugar.

Cyanosis: bluish discoloration of the skin and mucous membranes that appears when the rate of reduced hemoglobin in the blood is equal or greater than 5 g / dl.

Cyclooxygenase (COX)**:** enzyme that acting on acidity arachidonic acid, catalyzes the synthesis of prostaglandins.

Cyclooxygenase 1 (COX-1)**:** enzyme association, and always active in the body, which is responsible for the synthesis of prostaglandins with physiological functions in different organs, including stomach, kidney, and platelets.

Cyclooxygenase 2 (cox-2)**:** "inducible"enzyme, which is only activated in the presence of an inflammatory process and is responsible for the synthesis of prostaglandin mediators of inflammation. This enzyme is the target of specific inhibitors designed to lock in a highly selective inflammatory prostaglandins.

Cyclothymia: alternating episodes of depression and mental excitement.

D-

Defibrillator: apparatus capable of blocking the cardiac fibrillation by electric shock.

Delirium: psychopathological condition characterized by the production of thoughts, words or actions without meaning

Diabetes insipidus: disease characterized by the emission of large amounts of urine from the kidney due to difficulties in retaining water

Diabetes mellitus: disease caused by insufficient secretion of insulin from the pancreas or tissue resistance to insulin.

Diathesis: preparation of the body to specific diseases diffusion. Process by which a gas or a substance in solution expands due to the movement of its particles to fill all space at disposal.

DIC: disseminated intravascular coagulation.

Digital: Digitalis lanata extract used in heart failure. Normally it reduces the heart rate but in overdose can cause various types of arrhythmias.

Diplopia or amblyopia: double vision.

Disorientation: loss of space-time orientation.

Dissecting aneurysm: aneurysm in which an arterial intimal tear is produced, with dissection of the tunica media.

DNA: abbreviation of deoxyribonucleic acid. It is present in the nucleus of every cell, as a carrier of genetic information.

Dopamine. (Dopa): 3,4-dihydroxyphenylalanine, derivative of phenylalanine. Neurotransmitter in the central nervous system. Direct precursor of adrenaline and noradrenaline.

Doppler (cardiac or vascular): cardiac and vascular ultrasound. It also allows the study of the velocity of blood (quantity, quality and direction).

Doppler ultrasound: cardiac and vascular ultrasound. It also allows the study of the velocity of blood and the color display of blood flow .

Doppler: ultrasound for the determination of blood velocity.

Dromotropic: it matters the intracardiac conduction of the excitatory stimulus.

Drop attack: syndrome, characterized by falling to the ground for vertebral artery stenosis**.**

Dynamics: study of bodies in motion.

Dysarthria: imperfect articulation of speech due to disturbances of muscular control member to its production.

Dyskinesia: alteration of the movement.

Dyslexia disorder: difficulty to read and understand what you read.

Dysphasia: alteration of the language with lack of coordination and inability to have the words in the right order.

Dyspnea: difficulty in breathing. Subjective sensation of breathlessness**.**

E-

e.a.s: Left-front hemiblock (block of the conduction of the anterior-superior hemibranch of the bundle of his.

E.c.g: electrocardiogram or registration of electrical events of the heart.

Eating style: food style does not mean a "diet" but a method of balanced nutrition made of basic elements that should always be present in the right dose.

ECC: extra corporeal circulation.

ECG T wave: part of the complex ventricular that corresponds to the repolarization of the ventricles.

Echocardiogram: cardiac ultrasound that allows to record the echoes caused by ultrasound probes for the study of dimensions and movements of cardiac structures.

Echocardiography: cardiac ultrasound after administration of substances able to identify motion abnormalities not otherwise obvious.

ECST: european carotid surgery trial.

Ectropion: overthrow outside of the eyelid.

Elastase: enzyme that degrades elastin.

Elastin: yellow scleroprotein, essential constituent of yellow elastic connective tissue. It is fragile when dehydrated, elastic and flexible when wet.

Electrolytes: substances in solution (eg blood plasma) dissociate into ions (sodium, chlorine, potassium, magnesium ...).

Embolus: free particle in the bloodstream of various kinds (thrombotic, gas, fat, cancer, septic, mycotic material) immiscible with the blood vessel; it can lead to obstruction.

Emphysema: pathological accumulation of air in tissues or organs

Endocarditis: endocardium inflammation.

Endocrine system: term referring to organs or structures whose function is to secrete into the blood or lymph a substance (hormone) with specific effects on other organ.

Enzyme: protein molecule that catalyzes (speeds up) chemical reactions.

Epilepsy: paroxysmal transient disturbance of brain function manifested by episodes of deterioration or loss of consciousness, such as abnormal motor phenomena, mental or sensory disturbances or central nervous system perturbations.

Epistaxis: bleeding from the nose.

Erythropoietin: glycoprotein hormone secreted by the adult kidney and liver in fetal life; it stimulates stem cells from bone marrow to produce red blood cells.

Exocrine: secreting outward through a duct.

Exophthalmos: protrusion of the eyeball.

Extrasystole or premature beat: cardiac contra-action of premature ectopic, supraventricular or ventricular origin.

F -

Fainting : situation characterized by clouding of the consciousness accompanied by neurodegenerative disorders (cold sweat, nausea), reduction in blood pressure, tachycardia, difficulty in breathing.

Fans: Non-steroidal anti-inflammatory drugs.

FEV1: forced expiratory volume in 1 second.

FFA: free fatty acids.

Fibrinogen: coagulation factor, it is transformed into fibrin by the addition of thrombin.

Fibrosis: production of fibrous tissue; fibrous degeneration.

Filariasis.:disease mainly spread in the tropics, transmitted by certain types of mosquitoes that host larvae. The adult worm can invade the lymphatic system producing obstruction.

Folate: anionic form of folic acid.

Folic acid: also known as vitamin B 9 vitamin B c or folacin) and folate (the naturally occurring form), as well as pteroyl- L-glutamic. It is a vitamin complex which serves as a conveyor of the monocarboniose units in many metabolic reactions.

Framingam: American town where a major epidemiological study on cardiovascular diseases was made.

Frequency: number of cycles of a periodic motion or number of waves passing through a point per unit time (seconds) or number of oscillations of a pendulum in a minute.

Friction: the force that opposes or favors the slow movement.

Fsh: a hormone produced by the pituitary, which stimulates in women the growth of the ovarian follicle and sperm production in men.

FVC: forced vital capacity.

G -

Gamma fibers: nerve fibers from the gamma motor neurons located in the anterior horn of the spinal cord. Their function is to stimulate the elongation of the neuromuscular spindles. These fibers are divided into dynamic or gamma fiber 1 and static gamma 2 with the task, respectively, to vary **Gaba:** γ-aminobutyric acid.

Gangrene: tissue necrosis due to the stop of blood supply, usually located at the extremities

Gastrin: polypeptide hormone released in the gastric antrum by the action of peptidergic fibers of the vagus nerve on cells g of pyloric glands.

Gene: a unit composed of DNA responsible, with other genes, of the transmission of hereditary characteristics.

Genome: it is the entirety of an organism's hereditary information. In a eukaryote it is a set of chromosomes, in bacteria it is a single chromosome and in viruses it is a molecule of DNA or RNA.

Genotype: entire genetic makeup of an individual.

Gestosis: any toxemic manifestation in pregnancy.

Glaucoma: increased intraocular pressure.

Glomerulonephritis: inflammatory disease that affects the renal glomerulus.

Glucagon: polypeptide hormone secreted by alpha cells of pancreatic islets of Langerhans in response to hypoglycemia or to stimulation by the growthof the hormone of the anterior pituitary. It has the opposite action to that of insulin.

Glucocorticoid: each of a group of corticosteroids of 21 carbon atoms which act primarily on the metabolism of carbohydrates.

Gluconeogenesis: formation of glucose from glycogen.

Glutathione: tripeptide that contains an unusual peptide linkage between the amine group of cysteine and the carboxyl group of the glutamate.

Glutathione-peroxidase: enzyme belonging to the oxidoreductase. It reduces hydrogen peroxide, which is formed inside cells and is toxic.

Glycogen: glucose polymer that is formed in the liver where it is stored. It is found to a lesser extent also in the muscle. In case of need it is turned into glucose (gluconeogenesis).

Glycogenesis: production of glucose in the body, especially in the liver.

Glycosaminoglycan: mucopolysaccharide without the protein.

Glycosuria: the presence of glucose in urine.

Grazing Friction: the force that opposes or reduces the sliding of a body or surface against another.

Gout: disease caused by the increased excess of uric acid that causes a painful deposition of salts in the joints.

Ground substance anista (SFA): amorphous material similar to a gel in which are embedded the cells and the fibers of connective tissue

H-

Hallucination: distorted perception of objects, sounds or images.

Hallux valgus: deviation of the big toe outward.

Hallux varus: deviation of the big toe inward.

Heart failure: clinical syndrome characterized by the inability of the heart to ensure the needs of oxygen to the tissues.

Helicobacter pylori: gram-negative bacteria whose environment is best represented by the stomach. It is resistant to acid, is the most important causative agent of chronic gastritis and ulcer disease.

Herpes zoster (or area)**:** virus responsible for a unilateral vesicular eruption along the course of a nerve, very itchy and painful.

Hematocrit: analysis of the elements and the characteristics of the blood (red cells, white cells, platelets).

Hematuria: loss of blood in the urine.

Hemianopia: unilateral or bilateral blindness of half visual field

Hemiplegia: partial or complete paralysis of one half of the body.

Hemolysis: rupture of red blood cells to leak hemoglobin.

Hemoptysis: leaking of blood from the mouth coming from the breathing apparatus.

Heparin: physiological anticoagulant. It has mainly antithrombin action. Therapy using calcium or low molecular weight heparins (LMWH), especially for preventing embolism (trauma, immobility that predispose to venous thrombosis).

Herniated disc: protrusion of the pulpous nucleus or fibrosis annulus of the spinal disc, which can damage the nerve roots.

Holter (system, method h.)**:** registration for at least 24 hours of the electrocardiogram (Holter ECG).

Homocysteine: product of transmethylation of methionine; an intermediate product in the synthesis of cysteine.

Homocystinuria: accumulation of homocysteine in plasma and urine secondary to aminoacidopatia inherited as an autosomal recessive trait.

Hypercapnia: Increasing of the concentration of carbon dioxide

Hyperemia: increased amount of blood present in the capillaries of an organ.

Hyperesthesia: increased sensitivity to a stimulus.

Hyperkalemia: pathological increase in the concentration of potassium in the blood.

Hyperplasia: increase in the number of cells of an organ.

Hypertrichosis: excessive growth of ha**ir.**

Hypertrophy: enlargement of an organ or a part related to an increase in the size of its cells.

Hypokinesia: restriction of movement**.**

Hyponatremia: pathological reduction of the concentration of sodium in the blood.

Hypoplasia: incomplete development or underdevelopment of an organ or tissue.

Hypoxia: reduction of oxygen content.

Hypothermia: temperature reduction.

I -

IADL (Instrumental Activities of Daily Living)**:** activities related to the degree of independence of the elderly in instrumental skills of daily living such as the use of means of transport, in shopping, in the use the phone or of drugs.

Iatrogenic: it is related to a drug treatment.

Idiopathic: of unknown origin or self-originated.

Ig: immunoglobulins. Glycoproteins with antibody activity divided into five classes**:** IgM, IgA, IgG, IgD, IgE.

Illness or disease: any alteration or interruption of the normal structure or function of an organ, system or part of it. It is manifested by a characteristic group of signs and symptoms.

Infarction: cell necrosis at the expense of an organ (eg heart, lung, intestine, kidney) due to vascular causes.

Interleukin (IL): group of proteins produced in response to antigenic stimulation or phytogenic, often inflammatory markers. IL is very similar to the indogen pyrogens

Incidence: It is said of events that are generated from scratch (eg disease) in a given period of time.

Ionotropic: is said of everything concerning the contractility of the myocardial fibers: positive if it increases, negative if it decreases.

Ischemia: situation of cellular suffering connected with the reduction in oxygen supply due to vascular causes.

Isokinetic: with constant angular velocity of contraction.

Isometric contraction: contraction at constant length (without an appreciable decrease in muscle length).

Isotonic contraction: contraction constant voltage (contraction against a constant load with shortening of the muscle).

J-

Jaundice: yellowing of the skin due to an increase of plasma bilirubin.

K -

Keratitis: inflammation of the cornea.

Ketone bodies: organic compounds containing carbonyl groups with carbohydrates linked to carbon atoms of the carbonyl (eg acetone). Ketone bodies can be seen in poorly controlled diabetes and fasting kinds

Analgesic: drugs with pain-relieving properties.

Kinematics: study of movement in terms of its trajectory and its spatiotemporal aspects, namely, f its relations between position, velocity and acceleration.

Kinetics: study of movement from the perspective of the forces that determine or restrict it.

Kinking: kinking of a vessel (common in carotid artery).

Kyphosis: pathological increase in the convexity of the thoracic spine.

L -

Lactate:. anionic form of lactic acid.

Lactic acid: acid substance produced by the muscle for anaerobic glycolysis during intense exercise. It can be transformed into glucose by the liver.

Laplace (Law): a principle of physics that the tension on the wall of a sphere is the product of the pressure times the radius of the chamber and the tension is inversely related to the thickness of the wall.

Lbbb: left bundle branch block; total, permanent or intermittent interruption of trasmission in the trunk of the right branch of His bundle before the first division in the two emibranche.

Lec: extracellular fluid.

Leukemia: malignant neoplastic proliferation of leucopoietic tissue (specialized in the production of white blood cells or leukocytes).

Leukocytosis: increase of leukocytes in the blood.

Leukopenia: reduction of leukocytes in the blood.

Leukotrienes: they are formed from arachidonic acid and are composed of a linear chain of carboxylic acids with 20 carbon atoms with one or two molecules of o2 to replace two or more conjugated bonds. It acts as regulators of inflammatory and allergic reactions.

Lien: denomination of the spleen.

Lipofuscin: lipid granular pigment cell degeneration resulting from oxidation and polymerization of membrane lipids.

Lipolysis: breaking down or splitting of the fat .

Listesis: slippage of one vertebra with or without displacement.

Locus of control: process of attribution of causality of events in life (itself) or outside (various causes).

Lordosis: curvature of the spine with anterior convexity. It refers both to the physiological and the pathological aspects.

Lymphedema: edema related to obstruction, disruption or compression of the lymphatic vessels.

Lymphoma: malignant neoplastic proliferation of lymphoid tissue.Lymphomas can be divided into Hodgkin's lymphoma and non-Hodgkin's type.

Lymphosarcoma: diffuse lymphoma.

M –

Macroglossia: excessive size or increased size of the tongue.

Macrophages**:** cells originating from bone marrow and entering the bloodstream as monocytes. Once it reaches the tissues get bigger and acquire phagocytic capacity (ie, able to incorporate, ingest certain substances), becoming macrophages.

Mediastinum: area bounded by the sternum, the spine and the thoracic aperture. It contains the organs, nerves and vessels including the heart, trachea, esophagus, bronchi.

Meta-analysis: statistical technique which combines quantitative data from several studies conducted on the same subject by creating a single data for the final answer to a specific clinical question.

Methacholine: cholinergic agonist that has a duration of action compared to acetylcholine. It has vasodilator and parasympathomimetic action.

Methemoglobin: it is formed when iron in hemoglobin is oxidized due to genetic disease or toxic agents and it provokes cyanosis when increasing above normal values (minimum).

Miomalacia: softening of a muscle.

Miopragia: decreased functional activity.

Mioressi: muscle rupture.

Miosis or cormiosi: contraction of the pupil.

Mirror neurons: they are a class of specific neurons that are activated when you perform an action and when you look someone else performing it. The neuron of the observer so "mirror" the behavior observed, as if performing the action himself. These neurons have been identified in primates, in some birds and in humans. Giacomo Rizzolatti of the University of Parma discovered the mirror neurons.

Mitral valve prolapse: Mitral valve (one or both edges) in the atrium that prolapses in systole. It may be accompanied by regurgitation; it can cause arrhythmias. It should be done antibiotic prophylaxis during surgical maneuvers or bacterial diseases.

Mole: molecular weight of a substance expressed in grams.

Moya-moya: vascular disease of unknown etiology that affects the cerebral arteries with development of collateral circulation and the onset of multiple infarcts.

MRI: diagnostic procedure that produces images of the body based on exposure to magnetic fields.

Multiple sclerosis: neurological disease that damages the myelin sheaths surrounding the brain and the spinal nerves.

Muscle flaccidity: it follows the lesion of the motor nerve in which the muscle does not provide tensile strength.

Muscle spurt.: muscle that has the item very close to the fulcrum. Functionally the rotary component of the motion prevails.

Muscle tone: the resistance offered by a muscle strain.

Mycosis: disease caused by parasitic fungi.

Mydriasis or corectasia: pupil dilation.

Myocarditis: myocardial inflammation.

Myogelosis:. a condition in which there are hardened areas or nodules within muscles, especially the gluteal muscles ..

Myogenesis: development of muscle tissue, in particular the embryo.

Myoglobin: O_2 muscle pigment transporter. It is like a single unit of hemoglobin, being composed of a globin and heme group with an iron atom. It delivers O_2 released from erythrocytes to the mitochondria of muscle cells.

Myoglobinuria: presence of myoglobin in the urine. In some diseases it may occur also after prolonged and intense exercise.

Myolysis: disintegration or degradation of muscle tissue.

Myoma: tumor consisting of muscular elements.

Myonecrosis: necrosis of individual muscle fibers.

Myopathy: generic muscular disease.

Myoplastica: plastic surgery of a muscle.

Myosin: contractile protein present in skeletal muscle.

Myositis: inflammation of a voluntary muscle.

Myotasic: on the proprioception of the muscles.

Myotatic: performed or produced by muscle strain.

Myotomy: incision or dissection of a muscle or muscle tissue.

Myotonia: increased irritability and contractility with reduced muscle relaxation, a tonic spasm of the muscle.

Myotrophy: nutrition of the muscle.

N-

NASCET: North American Symptomatic endarterectomy trial.

Natriuretic factor: agent that causes elimination of sodium in the urine.

Necrosis: cell death, tissue destruction.

Negative predictive value: it expresses the probability that the person with negative test has to be sick. The higher it is, the greater the specificity of the test is.

Neurosis: mental disorder in which the perception of the reality is intact.

Nitric oxide or nitric oxide: substance produced by the vascular endothelium in vasodilating action.

Noradrenaline (norepinephrine): secreted catecholamine by the adrenal medulla and post-ganglionic adrenergic fibers. Potent vasoconstrictor.

NYHA:. See classes no.

NYHA classes.:heart failure may be acute or chronic, which may be classified into 4 classes as proposed by the New York Heart Association (NYHA) based on the relationship between symptom and effort required to provoke it.

O-

Obla: onset blood lactate accumulation. Lactate threshold, which corresponds to his store when it reaches the plasma concentration of 4 mmol / l.

Opioids: series of natural peptides such as enkephalins, which exert effects similar to those of opioids interacting with specific receptors on cell membranes.

Organ of Corti: Spiral organ. ortopnea body. respiration affected by the upright position, with greater difficulty breathing in the supine position.

Orthopnea: respiratory difficulty except in an upright position.

Orthostatic hypotension: reduction of blood pressure in the transition from a lying or sitting to a standing position of at least 40 mm Hg for systolic and 30 mmHg for diastolic.

Osmolality: number of osmolytes per kg of solvent.

Osmosis: phenomenon corresponding to the diffusion of solvent molecules to a region of greater solute concentration at which the membrane is impermeable.

Osteitis: bone inflammation.

Osteoblasts: fibroblast cells that reached the mature phase are associated with the production of bone.

Osteochondritis: inflammation of bone and cartilage.

Osteoclasts: large multinucleated cells that deal with the absorption and the reshaping of the bones

Osteoma: tumor composed by bone tissue.

Osteomalacia: condition characterized by bone softening (due to imperfect mineralization), with excess osteoid staff. It is the equivalent of rickets in adults.

Osteomyelitis: inflammation of bone and bone marrow caused by germs pyogenic (pus-producing germs).

Osteopenia: reduction of bone mass. osteoporosis. reduction in bone mass with a higher percentage than the depletion osteopenia (with standard deviation> 2.5 compared to normal).

Osteosarcoma: malignant neoplasia of bones.

P -

P wave of the ECG: corresponds to the depolarization (contraction) of industry.

Palpitations: sudden, transient sensation of altered functioning of the heart

Paralympics: the Paralympic Games, or Paralympic Games, are the equivalent of the Olympics for athletes with physical disabilities, visual or intellectual. Thought as parallel Olympics, they take their name from the merger of the prefix para Olympics with the word and its derivatives. The Law no. 189, July 15, 2003 ("Rules for the promotion of sport by disabled people ") refers to the Italian Federation of Sports for the Disabled as Italian Paralympic Committee (CIP).

Paraparesis: paresis of both lower limbs.

Paraplegia: paralysis of both lower limbs.

Parasympathetic effect: see parasympathetic.

Parasympathetic: effect of p. set of changes induced by the vagus nerve: pupillary constriction, salivation, bradycardia, sweating.

Paresis: reduction in strength and / or function.

Paresthesia: abnormal perception as burning, tingling, pricking, stitching.

Parkinson: disease characterized by tremor, rigidity and slow movement.

Pericarditis: inflammation of the pericardium. It may be autoimmune, viral or bacterial, traumatic, neoplastic.

Ph: the pH of a solution is the base-10 logarithm of the reciprocal of the concentration of H +, that is the negative logarithm of the concentration of hydrogen ions. The pH of the water at 25 ° C, where there are H + and OH-in equal quantities, is 7. From this value, for each decrease of pH by one unit, there is an increase of 10 times the concentration of H +, while for each increase of pH by one unit, there is a reduction of 10 times the concentration of H +.

Phenotype: all physical, biochemical and physiological characteristics of an individual that is genetically determined as well as by the environment, as opposed to genotype.

Phlebitis: inflammation of a vein.

Phospholipid (phosphatide): compound containing one or two molecules of fatty acid, a molecule of alcohol and a basic nitrogen in nature.

Piastronopenia: lack of circulating blood platelets.

Pituitary: gland at the base of the skull**.** (contraction and misalignment).

Platelets: increase in the number of circulating platelets in the blood.

Pleiotropy: quality of a gene to express itself in more than one way, namely to produce more than one phenotypic expression.

Pneumonectomy: removal (or excision) lung surger

Pneumothorax: accumulation of air or gas in the pleural space.

Point prevalence: defines the events (eg disease) present in a given time and referred to a defined population

Polygon of Willis: polygonal shape characteristic of the arteries of the cranial base.

Polyuria: Increased production of urine.

Portal vein: a vein that carries blood from the intestines to the liver, spleen and stomach.

Positive predictive value: it expresses the probability that the person with positive test has to be sick. The higher it is, the greater the sensitivity of the test is.

Posture: it is the ratio of joints and muscles and tendons that our body creates from its center of gravity and the base plate, according to the positions they assume, in order to maintain stability and counter the force of gravity .

Pot: a synonym for artery, vein or lymphatic

Pre-load: it means the load borne by the muscle when it is in idle state; it relaxes the muscle that is at rest, and it directly depends on the increase in diastolic volume of the RV.

Prevalence period case: defining events (eg disease) present in the population over a given period of time.

Prinzmetal : angina pectoris con manifestazioni e caratteristiche particolari; si può ritrovare anche in pazienti con coronarie indenni.

Prostacyclin: derivatives of arachidonic acid via intermediates, they are potent vasodilators and inhibitors of platelet aggregation.

Proteinuria: protein loss through the urine, often in the course of renal disease in the glomeruli

Proteoglycans: substances found mainly in the matrix of connective tissues in which many glycosaminoglycan chains are attached covalently to a core protein as the bristles of a brush for bottles

Proteolysis: lysis, dissolution, separation of proteins by hydrolysis of peptide bonds.

Protidogramma: analysis of various blood protein fractions (albumin and globulin).

Psychosis: mental disorder characterized by delusions, hallucinations, abnormal speech and behavior that the person has no awareness.

Ptosis: Prolapse of an organ or part.

Ptyalism: excessive secretion of saliva.

Pulmonary heart disease (acute or chronic)**:** Right ventricular failure due to pulmonary disease conditions (eg, embolism, pulmonary hypertension, COPD).

Pyrogens: substances released by the body (endogenous pyrogens) or external agents that may be, for example bacterial or viral (exogenous pyrogen); they can cause fever (or pyrexia).

Q-

QRS (complex)**:** it corresponds to the depolarization (contraction) of the inter-ventricular septum and both ventricles.

R-

Rabdiomiolisi: destruction of skeletal muscle due to infection or intoxication.

Raynaud (disorder, syndrome, phenomenon)**:** ischemia followed by cyanosis and asphyxia with local loss of sensitivity

Rbbb: right bundle branch block; total, permanent or intermittent interruption of trasmission in the trunk of the right branch of His bundle before the first division in the two emibranche.

Rolling friction: the force that opposes the rolling of a round or roundish body over another similar body or a different surface.

Receptive: structure belonging to the nervous system that is used to transfer a message.

Rectocele**:** rectal wall prolapse.

Relative risk: ratio between the frequency of the incidence of a disease among individuals exposed to a particular risk factor and the frequency of the non-exposed ones.

Release Height: the height above the ground level(reference system) or the height above the point of landing, to which a body is thrown or otherwise undergoes a push that causes its movement.

Rheumatoid factor (RF): this term indicates antibodies directed against antigenic determinants of the Fc portion of IgG ; it is found in 80% of rheumatoid arthritis (in 20% of juveniles).

Rickets: it is a disorder caused by a deficiency of vitamin D, most commonly in children and teenagers, with abnormal ossification.

Riflex: fast and simple movement, at the base of automatic movements in response to noxious, proprioceptive, exteroceptive or enteroceptive stimuli

Rigidity: increase of the muscle tone of the agonist and antagonist muscles with resistance to the passive movement.

Rom: range of motion. It is used to measure joint mobility.

S-

Saccule: the smallest of the two divisions of the membranous labyrinth of the vestibule, the part that communicates with the cochlear duct by the ductus reuniens.

Sarcoidosis: systemic chronic disease, characterized by the presence of granulomas in many organs of the body, especially lungs, lymph nodes and liver

Sarcoma: malignant tumor that arises from connective structures.

Sarcopenia: a reduction in the number of muscle fibers.

Sarcoplasm: interfibrillare matter of a striated muscle.

Saturnism: lead poisoning

Schizophrenia: mental illness characterized by the alteration of the process of thinking, of the contact with the reality and the emotional reactivity

Scintigraphy: reproduction of bidimensional structures and organs through the recording of radiation emitted by tissues after the introduction of various radionuclides in the body.

Sclera: the white of the eye, visible externally

Scleroderma: skin disorders characterized by thickening and hardening of the skin with subcutaneous tissue, and sometimes deep tissue

Scoliosis: lateral deviation, relative to the central spine.

Scotoma: black spot that affects a part of the visual field

Secretin: peptide hormone secreted by the duodenum and fasting. It stimulates the pancreas to release bicarbonate and water which change the pH in the duodenum

Sedimentation rate (ESR): it measures the time required for the corpuscular part of a sample of blood plasma in the sediments.

Sensitivity: it is given by the proportion of patients who test positive to a test (true positives), and those who come out negative are false negatives.

Serotonin: a vasoconstrictor substance synthesized in the nervous system or the intestinal chromaffin cells.

Shunt muscle: muscle that functionally overrides the axial component of movement. It rather than producing observable motion, contracts to resist dislocating forces occurring at joints, the coracobrachialis, short head of biceps, and long head of triceps all contract to resist downward dislocating forces at the shoulder joint, as when toting luggage.

Shunt: passage or anastomosis between two natural channels, especially between blood vessels.

Sickling and sickle cell anemia: hereditary hemolytic anemia due to a genetic alteration of hemoglobin

Sign: evidence indicating the presence of something. The sign, opposite to the symptom (which is manifested by the patient), can be objectively found by the observer.

SLE (systemic lupus erythematosus)**:** multisystem inflammatory disorder of connective tissue involving the skin, joints, serous membranes and some organs.

Sna: autonomic nervous system.

Somatostatin: peptide produced mainly by the hypothalamus and the delta cells of the pancreas. It inhibits the release of growth hormone, of the thyrotropin and of corticotropin by the pituitary, insulin and glucagon, gastrin, secretin, and renin.

Spasm: involuntary contraction, sudden and violent of a muscle or muscle group.

Spasticity: increased tone (hypertonia) of agonist muscles with accentuation of tendon reflexes.

Specificity: it is given by the proportion of animals which are negative to a test (true negatives), the healthy who are positive are false positives.

Spherocytosis: hereditary hemolytic anemia. It is often associated to jaundice and splenomegaly.

Spina bifida: a developmental abnormality characterized by defective closure of the scaffold with possible bony protrusion of the spinal cord and spinal meninges.

Splenomegaly: increase in size of the spleen.

Sprue: malabsorption syndrome, chronic.

Starling (Law): the energy of cardiac contraction is proportional to the initial length of myocardial fibers (the degree of preload) in direct relation to the diastolic volume.

Steatosis: fatty degeneration, commonly the liver.

Stent: garrison consists of a small tube that is inserted through the catheter after angioplasty in stenosed artery to ensure patency.

Stiffness (rigidity): degree of resistance or tension of the muscle fibers as a result of their elongation.

Stretching: literally means stretching, tension. It more precisely identifies a particular technique that aids the improvement of quality muscle and joint of the subject through the stretch and the tension of muscle fibers and tendons.

Stroke: acute onset of focal brain lesion.

Subclavian steal phenomenon (SSP)**:** refers to subclavian artery steno-occlusive disease proximal to the origin of the vertebral artery and is associated with flow reversal in the vertebral artery. It produces a "brain steal" to ensure the blood supply to the ipsilateral upper limb. In these cases, the intense upper limb muscle activity may aggravate the condition of "steal" and can produce symptoms of cerebral hypoperfusion, most of which are dramatical.

Substance p.: 11 amonoacidi peptide present in nerve cells and endocrine cells of the intestine. It increases smooth and gastrontestinal muscle contraction and causes

vasodilation, it is attributed to a possible role as mediator of pain (the transmission of pain impulses.).

Superoxide dismutase: Enzino class of oxidoreductases. It has a protective function on the cell by the action of superoxide.

Surfactant: surfactant mainly consisting of phospholipids and produced by type II alveolar epithelial cells that cover the alveoli and reduces surface tension.

Sympathetic effect: see sympathetic.

Sympathetic: set of changes induced by adrenaline, such as mydriasis, tachycardia, vasoconstriction (alpha receptors), vasodilation (beta receptors).

Syncope: transient loss of postural tone and consciousness.

Syndrome: the complex of coexisting signs and symptoms

Synovitis: inflammation of the membrane covering the joints

T-

Tachycardia: increased heart rate.

Tea: tromboendoarteriectomia, surgical technique often used in internal carotid artery stenosis.

Tenesmus: constant need to urinate or defecate

Tetanus: sustained muscular contraction without periods of relax for the presence of rapidly repeated stimulation of activation of the contractile always before the release occurs.

Tetany: neuromuscular hyperexcitability due to a decline in the concentration of extracellular ionized calcium, it may be secondary to hyperventilation.

Tetraplegia: paralysis of four limbs

Thalassemia: hereditary hemolytic anemia since. Thalassemia or sickle cell anemia characterized by small red blood cells.

the speed and degree of stretching.

Threshold: greater (low threshold) or less (high threshold) capacity of excitability of a muscle fiber to nerve stimulation.

Thrombocytes: the other name of the platelets.

Thrombolysis: natural phenomenon or drug-induced, so the pre-formed thrombi are lysed

Thrombophilia: tendency to recurrence of thrombosis.

Thrombophlebitis: Inflammation of a vein associated with thrombosis of one or more segments.

Thromboxane (TX): an intermediate product of arachidonic acid metabolism. the tx a2 is a potent vasoconstrictor and inducer of platelet aggregation.

Thrombus: aggregation of blood factors in vivo, primarily platelets and fibrin that include cellular elements

Thyme: lymphoid organ consisting of two lobes located in the anterior and in the higher mediastinum.

TIA: transient ischemic attack. transient ischemic attack.

Time of flight: duration in which a body remains in the air without contact with other physical means (air or water). It depends on the angle of release, height of release, the force exerted on the body before release (vertical speed) than that the acceleration of gravity and air friction.

Tinnitus: is the perception of sound within the human ear not originated from the environment

Training: repetition of an exercise that requires physical effort, done with some intensity and aimed to improve performance.

Trigeminy: regular repetition of a premature beat (heartbeat) after two complexes of the basic rhythm.

Trypsin: enzyme that catalyzes the cleavage of peptide bonds. It is secreted by the pancreas as trypsinogen, later transformed into the small intestine.

U-

Utricle: the largest of the two parts of the membranous labyrinth, located in the posterosuperior region of the vestibule.

V-

Valgus: pathological condition in which the axis of a limb segment deviates outside from its normal position.

Valsalva (maneuver): forced expiration with closed glottis.

Valve insufficiency: situation created by the incontinence a valve (eg, cardiac or venous), causing regurgitation.

Valve stenosis: the situation characterized by a stenosis of a heart valve that reduces the outflow of blood.

Varus deformity: pathological condition in which the axis of a limb segment deviates within from its normal position

Vascular resistance: the force that opposes the flow of blood in the vessels. It is measured in dyn x sec x cm-5and it affects post-load.

Vasculitis: inflammation of a vessel, angiitis.

Vasopressin: the posterior lobe of the pituitary hormone with antidiuretic and vasoconstrictor hypertension

Vc: current volume

Ventricular fibrillation: the activation mechanism is similar to that of the atrial fibrillation. While in the AF , in spite of the atrial asystole, blood leeks by gravity from the atrium to the ventricle, the VF asystole is incompatible with life.

Ventricular pre-excitation: intracardiac conduction disorder characterized by the early activation of the ventricles due to the presence of additional nodal fiber bundles

Vertebral index (Delmas)**:** ratio between the height of the spine x 100 and its length measured in the sagittal plane. This ratio is considered normal with results between 94 and 96.

Vertigo: illusion of movement; it can be objective (which revolves around the space surrounding the subject) or subjective (the person who goes around to the surrounding space).

VIP: vasoactive intestinal polypeptide: vasoactive intestinal peptide.

Viscosity: it is characteristic of the muscle, it shows a dissipation of energy; this excess of energy expenditure is due, above all, to the increasing speed of the muscle's work.

Viscous friction or resistance of the medium: dependent force by a fluid (liquid or gas) which opposes the motion of a body immersed in it.

vitamin b12: cyanocobalamin.

W-

Whipple's disease: disease characterized by diarrhea with fatty stools, arthritis,emaciation and decreased strength secondary to deposits of fat in the gut.

Wrist: lifting perceived by palpating fingers artery surface wave associated with the shift from the blood.

X-

Xanthelasma: skin condition characterized by the appearance of yellowish spots, often symmetrical, to the internal angles of the upper eyelids.

Xanthoma: accumulation of cells rich in lipids (especially cholesterol) deposits that form skin or tendon

Xanthopsia: visual disturbance, to which all objects are yellow.

Xeroderma: Skin diseases with various skin lesions in congenital nature sensitive to ultraviolet radiation

Xeroderma: Skin that becomes dry, tough, especially for vitamin A deficiency

Xerophthalmia: dry eye.

Xerostomia: dry mouth mucosa.

Y-

Ymca: young man Catholic Association

Z-

Zoonoses: disease transmitted from animals to humans.