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CHAPTER II

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

Raffaello Molino Lova – Claudio Macchi

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.