AUXOLOGICAL DEVELOPMENT AND PHYSIOLOGY OF MOTOR ACTIVITY
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Auxology is the science that studies the laws that regulate the growth of the individual.
It identifies the characteristics of each chronological phase. It allows us to evaluate the body size quantitatively, the study body proportions, the harmony of development, and the analysis of the maturation state.

Various genetic and environmental factors that influence growth and development occur with significant individual variables.

By presenting these premises, it is necessary to establish parameters of "normality" to compare the subject's data in the study.

By studying large population groups, graphs called "percentiles of growth" have been constructed that constitute the reference standards.

Different percentiles were created for weight, height, and growth rate differently for males and females.
At the center of the graph, we find the 50 percentile that constitutes the median value, which is more frequent in the studied population.
The interval between 3 and 97 percentile is the normal interval (always in probabilistic terms).
Values above 97 or below 3 percentile could indicate a possible pathology and therefore merit further investigation.
Only 10% of the children in these groups are affected by problems.

The body mass index (BMI) is obtained by dividing the subject’s weight expressed in kg by the square of the height. The result is expressed in meters.
The value indicates whether the subject is normal weight, overweight, or underweight.

Also, the BMI has its trend, while in the adult, the reference values use a program that does not consider the age; the values change according to the period in of the developmental and age.

BMI is a straightforward value to detect. However, in sports, the values obtained are not entirely reliable, as they have been obtained from the study of a predominantly sedentary population and do not consider the individual’s body composition.

Weight is strongly influenced by body composition, and those who practice sports have a lean muscle mass higher than those who lead a sedentary life.
Lean mass weighs much more than fat.

The percentage of fat and lean mass varies at different ages. The fat well represented in the early ages of life is reduced until the age of 7 years, then increases gradually.

If we consider individuals sedentary or with moderate physical activity, there is a good correlation between BMI and body fat.

A complete evaluation should include the evaluation of plica (psychometry). Still, the great differences in the operator's manual skills limit its use in the pediatric field to specialist centers only.

Measuring the circumference of the waist is very useful and easy to use to evaluate the performance of the subjects, in all other cases.

The waist circumference is measured at the narrowest point of the abdomen. An obese child frequently has an increased rate of growth, which determines a higher stature before puberty, but this increase is then lost at the end of puberty itself.

Bone age is the leading indicator of the state of physical maturation of the individual. Bone maturation is a process that presents well-defined maturation stages that reach constant characteristics in the adult. Bone age correlates with the degree of somatic development in general, with pubertal development of the cardiovascular and endocrine systems.
It is challenging to assess a young athlete's degree of development and performance; this explains the importance of following the boy over time by providing multilateral stimuli.

STAGES OF MOTOR DEVELOPMENT IN CHILDHOOD
Very simplifying, we can say that there are four fundamental stages in the development of our organism :
from 0 to 1 year
from 1 to 6 years from 6 to 12 weapons over 12 years
The newborn makes automatic "instinctive" gestures that have a goal of survival and require help in everything. With the passing of a few months, gestures began to be intentional and aimed at something born of autonomous thinking. At one year, the child learns to walk, thus increasing his autonomy and the possibility of exploring the environment and therefore improving his knowledge. He knows slowly to solve the problems (falling, getting up, turning around, grabbing . climbing, etc.), which implies the automatic development of motor skills.
From 1 to 6 years, the child eats, sleeps, plays, moves, and manipulates objects freely and analogously among children of the same age. What in the future will differentiate one subject from another will be the way he "lives " and "processes " the stimuli received, and in this context, fits the function of the adult that helps to know and understand.
Up to the age of six, it is difficult to discern any gross differences between one individual and another, and any kind of evolution is still possible.
From 6 to 12 years begins the work of perfecting capacities.
It's the time when you have to pay more attention and interest to all the person's components.

The aim is to teach reading and writing; the tasks and commitments become more pressing.
The game during this period is more passive (video games, computers, etc.), and the time devoted to physical activity is drastically reduced, at the expense of the improvement of some essential qualities, such as coordination, balance, agility, agility, balance, laterality, etc.

Adult supervision is more important at this stage.

From 12 onwards, it is still possible to overcome certain shortcomings and develop other qualities such as strength and endurance. Still, this phase can not be exempt from a personal awareness and motivation that have roots in a good "education" in sport.

We can compare our body to a machine:
Like every machine, we must move to remain efficient and improve performance. Otherwise, we risk taking the "rust."
In particular, if it is not exercised, our every function loses effectiveness.

Physical training invigorates memory, will, and self-control, making any physical or mental effort less strenuous.

Of course, as in all things, you have to have balance.

However, much of the "physical damage" that we encounter with the passing of the years derives in some way from a sedentary life. The potentialities of our body are often exploited in minimal part,
To grow and maintain our qualities unaltered, we must educate all skills in a harmonious and balanced way by using the tools we have available nutrition, sport, rest, study, social relations, etc.. balanced.

The human personality and its motor abilities are so high and the things to learn so numerously, that the period of apprenticeship is very long compared to that of the other living species. Learning and capacity building lasts for many years with periods of acceleration and slowdown, just as we saw for somatic growth.

The various forms of growth, although not always synergistic, affect each other; so' improvements in the motor field have reflexes in the intellectual field and vice versa.

At each stage, we are predisposed to specific learning of personality topics. Therefore, it is important in each period to devote yourself to learning skills and abilities more suited to that age, and in the same way, it is wrong to repeat the same experiences too long. Respecting these simple rules allows the transformation of a city car in Formula 1.

The muscles constitute the active organs of the mechanical part. They consist of units called myofibrils, which have the characteristic of being excitable and contractile.
The brain controls muscle contraction thanks to nerve impulses from the cerebral cortex. The neurons descend along the spinal cord and reach the motor neurons in close contact with the muscle, causing muscle contraction.
Each muscle consists of thousands of muscle fibers of varying lengths, from 1 to 45 mm, each consisting of two proteins that can contract.
Actin is thinner, and myosin is thicker. The nervous stimulus causes a chemical reaction that causes the "slipping" one on the other of the two types of filaments. This movement is minimal but multiplied thousands of times over the entire muscle fiber length, causing the muscle to contract and move a muscle. Each motor neuron attaches to more than 150 muscle fibers at once. The set of motor neurons (nerve cells) and muscle fibers innervated by it is called a motor unit.
The muscles, in turn, attach themselves, through the tendons, to a system of levers, that is, the bones, which are moved quite passively by the muscles themselves.
Each muscle is made of fibers of 2 types:
rapid contraction and slow contraction. All threads of the same motor unit are of the same kind.

Fast-shrinking fibers contract quickly but quickly. They are large fibers, poorly watered with blood, and are more suitable for short and intense efforts.
The slow-shrinking fibers contract slowly and fatigue in longer times.
The slow fibers are highly vascularized and contain enzyme systems suitable for long-term activities.
The percentage of the two types of fiber of each of us is, for the most part, genetically determined; training can improve the performance of both types of fiber.

Recent animal studies also show that prolonged activity can cause the transformation of fast-shrinking fibers into slow-shrinking fibers, indicating muscle adaptability to training.

If, for example, we are engaged in an activity of resistance, such as a marathon, the central nervous system, through the motor neurons, begins to recruit the fibers of slow contraction and recruit fast-shrinking fibers only when we are fatigued or when we increase the cadence of the ride.

THE STRENGTH and SPEED of the displacement of the various segments depend, therefore, on the quantity and type of muscle fibers stimulated.
The muscles following nerve stimulation can produce physical energy (strength) using the chemical energy accumulated in the body.
This energy (strength) is produced by the cleavage of a substance called ATP (adenosine triphosphate) that transforms into ADP (adenosine diphosphate).
The ATP is always ready and present in our body, but in very small quantities, quickly exhausted in a few seconds of intense work, transforming into ADP.
ADP can be regenerated and transformed into ATP to be reused for energy production.
To rebuild the energy, our body has two systems:
-Energy storage tank
CP (phosphocreatine) which, when dissolved, provides the necessary molecule (p) for the transformation of ADP into ATP (adenosine diphosphate in adenysintriphosphate)
CP availability is minimal.
-Breakdown of sugars (glucose and glycogen) and degradation of fatty acids.

ANAEROBIC MECHANISM
That is, without using oxygen with a production of pyruvic acid and lactic acid.
This mechanism allows to sustain intense efforts and, in this case, of limited duration. When lactic acid reaches a certain concentration, it reduces the efficiency of the muscle to block it.
AEROBIC MECHANISM With the use of oxygen, this mechanism can demolish sugars and fatty acids by producing energy and
advancing as wastewater and carbon dioxide that is then eliminated with breathing and sweat.
This mechanism allows a job to be sustained for a long time under conditions that the effort is contained.
The respiratory capacity of the individual greatly conditions this mechanism, as it determines the possibility of oxygen supply.

We can compare the muscle to a combustion chamber where the energy stored in the body in the form of carbohydrates and fats is slowly transferred to the ATP and then released to produce the contraction of the muscle itself.
The transfer and liberation of energy can occur thanks to the action of enzymes that are molecules consisting of a larger part of a protein nature and a smaller part called a coenzyme.

The activity of these enzymes increases as the muscles warm up, so the energy production improves greatly with muscle warming.

Enzymes also work better at a certain PH. When muscle work produces lactic acid, and then the PH is lowered, it reduces the activity of these enzymes and consequently the production of energy, giving the feeling of fatigue.
Enzymes work better when we have more "fuel" to use, and that is why it is advisable to consume certain foods to increase the deposits at the time of need.
In addition, the concentration of enzymes is directly proportional to the degree of training. Training increases the concentration of enzymes.
During physical activity, there are different sources of energy that are used depending on the type of activity or phase of effort
an example :
if we walk, we consume mainly fat; if we move to slow running, our energy source will become a mixture of fat and carbohydrates. Moving from slow to fast, the primary source of energy will become glycogen (i.e., carbohydrates); if you finally switch to intense exercise (for example, a series of "shots, "glycogen will be the only source of energy.

This table summarizes by simplifying what are the sources of energy during the various types of activity:
rest: free fatty acids and glucose (fats and circulating sugar)
at the beginning of the exercise: creatine phosphate (CF) runs out immediately! glycogen (sugar stored in the muscles and liver)
during constant physical activity: free fatty acids, glucose, and glycogen
during the maximum effort - short and intense: CF - prolonged glycogen

In long-lasting physical activities (more than 80 minutes), the use of blood glucose (circulating in the blood) increases as muscle and liver glycogen stocks run out.
Finally, the sugar concentration in the blood also drops rapidly (hypoglycemia), resulting in a feeling of extreme fatigue. At this point, if we do not want to collapse, we must take sugar at ready availability (glucose) that will provide the energy needed to continue the effort.
In endurance activities, the use of fats increases with the duration of the activity itself. Fat mobilization is relatively low in the first half-hour of exercise but increases with time. Constant and prolonged training increases fat utilization.
As we have seen, oxygen is essential to carry out an aerobic activity, the most convenient one. Consequently, when we do not have oxygen available, we are forced to use less efficient metabolic pathways, that is, anaerobic pathways that produce less energy.
At the beginning of any activity, the entry of oxygen does not immediately meet the requirements for a few minutes. Therefore, a temporary "deficit " of oxygen is created, and the body relies on the immediate source of energy, that is the ATP the CF (creatine phosphate), which are already available, and since these two sources are depleted in a short time, uses sugars through anaerobic glycolysis, which leads to the formation of lactic acid.
When the oxygen intake begins to be sufficient, you get a "state of balance" physical activity can continue until you can cope with the energy demands of oxygen, which depends very much on the degree of training achieved.
In the recovery phase that follows exercise, an extra amount of oxygen is consumed compared to the basal resting condition, and this phase is called "oxygen debt" The extra oxygen consumed is used to remove lactic acid and replenish some of the energy consumed during the exercise.

BREATHING
Many people have experienced a "shortness of breath" after physical activity, but this feeling does not necessarily mean that oxygen is insufficient.
The functions of breathing are:

a) getting oxygen to the tissues
b) remove the carbon dioxide produced

a reduction in the ability to eliminate carbon dioxide can limit the ability to withstand intense physical activity.
Breathing is usually an involuntary act: air enters the lungs when the diaphragm contracts, creating a depression that sucks the air inside the lungs; when the diaphragm releases the air, which gives oxygen to the tissues charged with carbon dioxide, it is expelled.
During physical activity, the exhalation is helped by the abdominal and intercostal muscles, so breathing during physical activity requires some effort. This is why training for good breathing becomes essential because it will allow you to withstand fatigue better.

VENTILATION (f X VC)
Ventilation means the product obtained by multiplying the respiratory rate (f), the number of breaths per minute, the current volume (VC), and the amount of air entering and leaving our lungs for each respiratory act.
Although we can control the frequency and depth of breath, it is usually our autonomous system (that is, the one that works independently of our will) that can adjust the flow of air to the intensity of physical exercise.
In the joints, some receptors signal the need to increase ventilation. Some chemical receptors can evaluate the concentration of carbon dioxide in the blood. Our brain can use this information to adjust the frequency and depth of breath to the needs'.

Part of the air we inhale does not reach the alveoli, the seat where it can give off oxygen and load with carbon dioxide, but remains unused in the respiratory tract (nose, mouth, larynx, trachea, bronchi, etc.). If we take deeper breaths, we get more air to the lungs to the alveoli, making breathing more efficient. For this reason, more trained respiratory muscles can affect automatic breathing, making it possible to store more air with each breath.

PART 3

OXYGEN DIFFUSION AND TRANSPORT
oxygen through the inhaled air reaches the pulmonary alveoli.
Due to the difference in concentration passes through the blood, and the capillaries reach the muscles and organs. Carbon dioxide travels the opposite way. It enters the blood from the muscles and organs, then it passes from the blood to the lungs, and then it is expelled from the organism into the atmosphere.

HEMOGLOBIN
A small amount of oxygen dissolves directly in the blood, but most are transported by the hemoglobin contained in the red blood cells. Hemoglobin is a large molecule formed by four iron-containing sub-units. And every iron atom is like a little cart that binds an oxygen atom and transports it to the tissues. During physical activity, the use of oxygen at the level of the muscles can also increase by 20 times compared to basal values, thanks to greater blood flow.

The red blood cells are about 5 million per cubic mm; they form in the bone marrow and survive 120 days. Their production can be stimulated by the low oxygen concentration, such as that found at high altitudes. When the red blood cell dies, hemoglobin is degraded, but the iron that is contained in it is reused for the synthesis of new red blood cells. Adolescents often experience iron deficiency and adult women, and therefore an iron surplus is recommended in women and young people who are engaged in intense resistance activity.

THE HEART

The heart is a muscle, and it is the endurance muscle par excellence.
It ' consists of two pumps: the right one (pulmonary pump) that sends blood to the lungs and the left (systemic pomp) that pumps blood to the rest of the body.
The red blood cells reach the heart after transporting oxygen to the body's muscles through the hollow veins that flow into the right atrium. The atrium contraction causes the blood to flow to the right ventricle.

Due to the contraction of the ventricle, the blood is pushed to the lungs. The blood through the pulmonary circulation is loaded with oxygen and returns to the heart in the left atrium.
And from the left ventricle continues its path, through the aorta, to the muscles and organs of the periphery.

A part of the red blood cells is pushed directly and quickly into the coronary circulation, that is, into the arteries that carry oxygen directly to the heart.

Cardiac output depends on two factors :
heart rate (FC) is the number of contractions per minute
and cardiac output (GC) is the amount of blood expelled for each contraction.

CARDIAC OUTPUT = FC X GC

It is interesting to observe what happens to these parameters during exercise, that is when the oxygen demand increases.

HEART RATE AND EXERCISE

As the intensity of muscle work increases proportionally also, the heart rate
When exercise begins, the blood vessels that supply the skeletal muscle dilate to allow for greater blood supply. This dilation causes a decrease in blood pressure. Inside the blood vessels, there are organs (baroreceptors) that can detect these changes in pressure that warn the center in the brain responsible for cardiovascular control, which in turn sends the order to increase the heart rate and, to a limited extent, also the throw. so heart rate is an excellent indicator of the intensity of exercise.

OXYGENATION OF THE HEART MUSCLE

As we anticipated before, the heart is oxygenated through the coronary circulation. Maintaining an adequate supply of oxygen is very important because the heart is not a particular muscle; it cannot use anaerobic sources of energy. During exercise, the heart increases the arrival of oxygen by increasing the flow in the coronary arteries. Intense static muscle contractions increase the cardiac oxygen demand and reduce the return of blood to the right heart, so it can happen that just when more oxygen is needed, its supply decreases. During the intense efforts, both the heart rate and the blood pressure increase considerably, and therefore it is always necessary to maintain due caution in untrained subjects who have narrowed coronary arteries. Conversely, healthy individuals can utilize endurance training to reduce the coronary risk factor.

MODIFICATION OF THE MUSCLES
The generic effect is to shape and highlight the muscles with an aesthetic improvement of the whole body:

INCREASED MUSCLE VOLUME AND STRENGTH
CHANGE OF THE LENGTH if it works by lengthening and shortening to the maximum of its possibilities, its belly will lengthen, assuming a tapered and elegant shape; otherwise, it will become shorter and stocky.

INCREASED VASCULARITY
Especially in the case of prolonged work of mild intensity increases the number of capillaries that spray it improving the oxygen supply.

INCREASE IN ENERGY SUBSTANCES
Exercise improves the deposit of energy substance (glycogen) at the level of the muscle itself.

IMPROVEMENT OF THE TRANSMISSION OF NERVE STIMULI
Nerve stimuli is transmitted to the muscles with more speed and precision, improving the coordination of movements.

CHANGES IN THE SKELETAL SYSTEM
Motor activity produces important modifications to the bones.

IMPROVED NUTRITION OF THE BONES
The increase in blood circulation increases the state of nutrition of the bone, improving the calcium intake.

INCREASE IN LENGTH AND THICKNESS
Physical activity promotes the production of new bone cells with an increase in the length of the bone and thus contributes to the increase in stature.

The traction of the muscles on the bones also favors the increase of the thickness, increasing its sturdiness.

CHANGES IN THE JOINTS MAINTENANCE AND RECOVERY OF PHYSIOLOGICAL MOBILITY
STRENGTHENING OF JOINT CAPSULES
Less prone to sprains and dislocations.

CHANGES IN THE RESPIRATION
REDUCTION OF RECOVERY TIME
After exertion, the trained subject takes much less time to return to normal breathing.

LOWER INCREASE IN RESPIRATORY RATE
At the same work, the trained subject has a lower respiratory rate (normal respiratory rate for an adult and about 12-18 breaths per minute).

INCREASED LIVING CAPACITY
The vital capacity is the amount of air, measured with a spirometer, which you can blow after a

maximum inspiration. The capacity depends on improved mobility of the rib cage and respiratory muscles that have become more powerful.

INCREASE IN APNEA TIME
CHANGES IN THE HEART AND CIRCULATORY SYSTEM
THE HEART CHANGES IN SHAPE AND SIZE
The heart takes on an almost spherical shape in athletes. It also increases the volume of its cavities, atria, and ventricles, and its walls thicken.

INCREASES THE SYSTOLIC RANGE
The amount of blood expelled at each contraction increases thanks to the volume of the cavities and muscle strength.

INCREASES CARDIAC OUTPUT
As a direct consequence of the above, blood circulating naturally increases.

REDUCTION OF THE NUMBER OF RESTING PULSES (BRADYCARDIA)
With constant training and prolonged training, like the one that athletes undergo, the heart rate can go from 70 -72 beats per minute detectable in the normal subject to a heart rate of 40 beats per minute.

REDUCTION OF RECOVERY TIMES
It decreases the time needed and returns to a basal heart rate after the effort.

INCREASED FLOW OF THE HEART
Increase the capillaries and the caliber of the coronaries

INCREASED CAPILLARIES IN THE MUSCLES
With a better oxygen supply, faster slag elimination

FACILITATION OF VENOUS RETURN TO THE HEART
During the movement, the muscles squeeze the veins that, thanks to the valves contained in them, convey the blood to the heart preventing stagnation and edema.

EFFECTS ON THE NERVOUS SYSTEM
IMPROVING THE NUTRITION OF NERVE CELLS BY IMPROVING THE CONDUCTION OF STIMULI, THESE OPERATIONS AUTOMATE THE MOVEMENT MAKING IT MORE ECONOMICAL AND ACCURATE

IMPROVING THE REACTION TIMES
IMPROVING COORDINATION AND GENERATING BALANCE
EFFECTS ON BODY WEIGHT CONTROL
Exercise is currently taking priority in weight loss and weight loss programs.
The diet alone causes a loss of fat and lean mass, lowering the metabolism and a tendency to resume the lost kg quickly.
By associating a regular physical activity, you save lean mass, the leading "consumer" of fat.

EFFECTS ON THE PERSONALITY
The motor activity develops attention and memory, and imaginative ability.
Regular physical movement improves many aspects of character by increasing will and self-control.

Good physical activity promotes socialization and a spirit of collaboration and respect for the rights of others.