AUCTORES
Globalize your Research

Journal of Orthopedics and Surgical Sports Medicine
Lázaro Martín Martínez Estupiñan *

Open Access

Research Article

Methodological Criteria on Strength Work In the Child Athlete in the Musculoskeletal System

Leonardo Martínez Aparicio [1], Lázaro Martín Martínez Estupiñan [2*], Luis Bretón Espinosa [3] Juan Carlos Cedré González[4] and Ernesto Ibañez Zamora [5].

University General Hospital "Mártires del 9 de Abril" Cuba

***Corresponding Author:** Lázaro Martín Martínez Estupiñan, University General Hospital "Mártires del 9 de Abril" Cuba.

Received Date: January 25, 2021; Accepted date: February 10, 2021; published date: March 06, 2021

Citation: Leonardo M Aparicio, Lázaro M.M Estupiñan, Luis B Espinosa,Juan C.C González and Ernesto I Zamora. (2022). Methodological criteria on strength work in the child athlete in the musculoskeletal system. *J. Orthopedics and Surgical Sports Medicine*. 5(1); DOI: 10.31579/2641-0427/29

Abstract

Strength training in child athletes is widely recommended by scientific organizations in charge of ensuring healthy training.

Purpose. It is intended to methodologically analyze, from the medical point of view, the conditions of strength training in child athletes and provide a group of knowledge about which there are different approaches and positions among our doctors and sports coaches.

Method: A systematic and detailed bibliographic review was carried out on the subject, using analytical-synthetic, historical-logical and inductive-deductive theoretical methods and documentary analysis as an empirical method.

Results: Strength training in the child athlete does not bring about an excessive increase in muscle volume, but an increase in resistance.From a physical perspective, strength is defined as the action that produces changes in the state of rest or movement of a body. Strength training can help to physically prepare child athletes to better cope with the high musculoskeletal demands of sports training and competition.

Conclusions: Among the general guidelines for strength training in child athletes is an adequate preseason evaluation, supervision, instruction and qualified teaching, guaranteeing a safe and risk-free environment.

Keywords: skeletalmusclel; strength training; child athlete

Introduction

Children's participation in sports is constantly increasing, adolescents worry about their appearance and sometimes use sports and strength training to improve their physique, but sometimes they do not have adequate guidance. 1The differences between the child athlete and the adult who practice sports have been written for a long time, their differences are significant, we have all had the possibility of realizing that they are not small adults, they are growing organisms.

In the wake of far-reaching attempts to convey concern about strength training in child athletes, the concept of participation in various forms of strength training has sparked interest among researchers, clinicians, and professional trainers.2

Although endurance and high intensity in training among children and youth was the subject of much controversy in the past, it is now well documented that this mode of training is a safe and effective way to maximize strength, depending on development and development. Athletic performance in the youth, provided the exercises are performed with appropriate supervision and precautions.3

Working strength in training leads to forcing this immature skeleton into potentially harmful conditions, this is considered by some authors as an intrinsic risk factor for SOMA injuries in child athletes. Strength training in child athletes is widely recommended by scientific organizations in charge of ensuring healthy training, there are multiple evidences that highlight the benefits derived from this activity, as long as it is carefully supervised by qualified technicians and the design of a program tailored to individual characteristics, needs and objectives.4

Currently there are different works that have shown how neuromuscular training has managed to improve different capacities related to this system; the sensation of joint position and movement, muscle activation patterns, and physical qualities such as strength and balance. In this way, in the athlete, throughout their preparation, from the initiation process to achieving a high level of sports performance, there are structural

modifications that have a high impact on the sport, such as increased mass and strength. Muscular, these characteristics, that distinguishes them.

This work aims to methodologically analyze the conditions of strength training in child athletes and provide a group of knowledge about which there are different approaches and positions among our doctors and sports coaches who work with child athletes.

Method

The results of the authors' experience obtained through more than 20 years of work, their participation in events, discussions, scientific debates, advising on master's thesis, and as courts in defense of the doctorate of science in the central region are presented. A systematic and detailed bibliographic review on the subject was carried out, using analytical-synthetic, historical-logical and inductive-deductive theoretical methods and documentary analysis as an empirical method. A detailed description of a group of methodological considerations on strength training in the child athlete was obtained.

Articles published in Latin America, the United States, Europe and Asia during the last five years were selected and, due to their importance, some with more than five years. The search was carried out in the databases Latin American Literature in Health Sciences (LILACS), Scientific Electronic Library Online (SciELO), PublicMedline (PubMed), Network of Scientific Journals of Latin America and the Caribbean, Spain and Portugal (Redalyc) and Health Inter-Net Access to Research in Health Program (HINARI). The search terms were selected from the descriptors in health sciences (DeCS): child athlete, physis, physeal damage, training, strength training.

Developing

The practice of sports activities with child athletes leads to constant improvement, recognizing best practices, novel innovations, the most experienced approaches, implies an improvement in the conditions of sports training and therefore a decrease in sports risks for the appearance of injuries of the osteomyoarticular system.

The principles of training are the basis and foundation of the general theory of training, without which the expected results cannot be obtained. Among them we find the principles that guarantee the initiation of the adaptive mechanism (effective stimulation of the load, progressive increase of the loads and the versatility of the load), the principles that guarantee the adaptation (the optimal relationship between load and recovery, of repetition and continuity and that of periodization) and the principles that guarantee the specific control of the adaptation processes (adaptation to the age and individuality of the athlete, progressive specialization, regulatory alternation between the different training elements and the functional unit).

In personalized training, the sports coach teacher tries to define the profile of the child athlete, paying special attention to certain aspects, such as their muscular and morphological qualities, age, their training experience and responsibility, fundamental according to skeletal and psychological maturation.

During childhood, strength increases linearly, with very little difference between the two sexes. However, during puberty, boys begin to increase rapidly, while girls continue with the same growth curve as in prepubertal age, leaving an average difference of about 50% at the end of puberty. With regard to muscle activation, children are less able to fully utilize type II fiber motor units.

The effectiveness, benefits and risks of strength training have been extensively studied in adults, otherwise, in child athletes there is much less information and this is much more uncertain. For many years, strength training was not recommended for child athletes for two reasons. First, because of their immature skeleton, it was believed that they were more prone to injury and possible interference with growth, and second, it was believed to be ineffective. 5 The extent of strength training among children is unknown.

Anatomical-physiological considerations

Strength training in the child athlete does not bring about an excessive increase in muscle volume, however, it does lead to an increase in resistance. There are traits that should not be lost sight of due to the physical characteristics of the child athlete, such as the resistance of the tissues, their physiology and their psychological conditions.

As important traits in this regard, the bone becomes stronger and more rigid with age, going from a flexural strength of 158 megapascal (MPa) at two years, 177 MPa at four years, 190 MPa at eight years, to 205 MPa at 16 years, close to the value of adult bone.Meanwhile, in the processes, and in general, in the ligamentous and tendinous attachments, something similar occurs to what happens in the epiphyses, given the great hormonal influence on the cartilage at these points; its resistance increases in the prepubertal period to about 57-61 Newton per kilogram (N / kg), decreases with the change of puberty to 55-57 N / kg, and then increases to 68-80 N / kg in the adult Tendons and ligaments go from a tensile strength of 30-40 MPa at 10 years of age, to 70 MPa at 20 years. The mechanical forces exerted by traction of the periosteum and perichondrium in the longitudinal direction, the tension of muscles and ligaments and static load play an important role in the local regulation of growth activity.

Tendons and ligaments also undergo a series of maturational changes during growth that modify their properties. Thus, tendons go from a tensile strength of 30-40 MPa at 10 years of age, and at 20 years it supports 70 MPa. Its elasticity decreases between those ages in a similar proportion. Something similar to what happens in the epiphyses occurs in the processes and in the ligamentous and tendinous attachments.

Given the great hormonal influence on cartilage, at these points its resistance increases in the prepubertal stage to about 57-61 N / kg of body weight, decreases with the change of the puberty stage to 55-57 N / kg of body weight, increasing later to 68-80 N / kg of body weight in the adult.

Mechanically, human cartilage behaves following the so-called KLM biphasic model (Kuei-Lai-Moque), it has time-dependent aspects in the load curve, deformation as a function of resistance to interstitial fluid transport, given by the permeability of the solid phase of cartilage (collagen and proteoglycans), both associated with mechanical stresses and with both ionic and electrostatic effects.

Generally, cartilage and bone tissue are subjected to muscle action, which insert into the periosteum of the diaphysis and metaphysis, during growth, these forces are capable of modifying the growth pattern, changes in tension in different areas of the periosteum and physis may be a factor leading to increased growth in certain bone portions.

Conceptualization of force.

Studying and developing updated knowledge on the strength training methodology, appropriate for each athlete and sport modality in order to optimize performance is a fundamental section where the main mechanical concepts associated with strength training must be analyzed and interrelated.

Strength and power are the most used mechanical variables in the context of sports training. From a physical perspective, we can define force as the action that produces changes in the state of rest or movement of a body or that produces deformations, force is the only “pure” capacity traditionally associated with the physical condition of the body. Athletes. Movement or its absence is a consequence of the application of force.

Mechanical and neurophysiological factors that justify the different levels of strength training, factors that influence an adequate training methodology for the development of explosive strength and strength-resistance, through the execution of exercises with overloads and specific exercises. There are multiple factors associated with the specific training level of the different manifestations of strength.

Force, velocity, acceleration, and power are mechanical variables derived from mass, distance, and time. For practical purposes, when the maximum possible intensity is applied in the displacement of a certain load or resistance, force, speed, acceleration and power can be used as synonymous concepts.

Strength is one of the main performance factors in most sports. In fact, a variation in motion can only occur if there is an application of force. The study of force is essential to optimize the performance of all sports modalities because in all it is necessary to apply force. To understand the methodology of strength training, it is required previously to differentiate and interrelate the main mechanical concepts associated with the application of force. It is also important to order and analyze the main variables that determine that the force required and the context in which it must be applied are very different, between the different sports modalities and motor actions. Recognizing these concepts is vital for the analysis from a medical point of view of strength work in children, specifically in the osteomyoarticular system.

Benefits of strength training

In children growth cartilage injuries are common, traction injuries are not rare, but accidents tend to cause sliding stresses on the physis. To prevent this, the physis usually presents undulations, which prevents these stresses from acting uniformly and at the same time. Over the whole of it. Sometimes the physeal plates of many bones form as great an angle as possible with the planes of maximum shear.

Currently, the analysis of physeal distraction has once again aroused interest in knowing the mechanical, histological and biochemical response of the growth cartilage.The area near the physis is, during growth, an ideal area to apply elongation methods due to its special characteristics to achieve However, a small intensity gradual distraction force acting symmetrically on the growth plate can, according to some authors, achieve bone growth without producing epiphysiolysis, constituting what has been called chondrodiastasis.

Structurally, a fresh tendon or ligament is an organic material composed of wavy collagen fibers that become longitudinal when a small tension is applied to them, equivalent to deformations of 4% of the initial length of the tendon; when the forces subside, the tendon reverts to its conventional morphology.

Tendons transmit and absorb forces in their direct insertion into the bone, this area is called enthesos and provides great resistance which makes bone pulling difficult, its fibers are mainly collagen, although we can also find elastic fibers, these join the bone and Sharpey's fibers are continued, this area has a poor vascularization. The anterior tuberosity of the tibia is considered a traction epiphysis that as such can undergo modifications due to the forces exerted on it by the patellar tendon, here a frequent disease appears produced by the excessive or constant increase of this tendon on its insertion in the bone, called Osgood Slatter disease [6, 7].

In recent times there has been a progressive increase in the number of children and adolescents who are selected to participate competitively at national and international level at increasingly early ages, demanding high levels of professionalization, increasing training loads in time and intensity, higher volume and frequency of competitions with insufficient time for recovery. Athletes have been subjected over time to sports selection parallel to Darwin's natural selection [8].

Exposure of the developing growth plates to sufficient mechanical stress through appropriate strength training may be a beneficial stimulus for bone formation and growth.There is no documented scientific evidence of possible damage to the growth plates, or adverse effects on the growth and stature of the child athlete. Most youth injuries that can occur during strength training are due to accidents caused by improper use of equipment, excessive training load, faulty execution technique, and / or lack of qualified supervision.

The benefits of practicing strength exercises with children can be classified into 4 large groups: motor benefits, health benefits, psychological / psychosocial benefits and injury prevention [9].

Strength training can help to physically prepare young athletes to cope with the high musculoskeletal demands of sports training and competition with greater guarantees.

As a result of strength training, the percentage of surface occupied by muscle fibers of the IB subtype is increased and the surface occupied by those of type 1 is reduced. Knowing how to recognize the potentialities of your pupils in sports initiation will promote a better adaptation to sport. Performance improvements in motor skills (jumping, running, throwing) in children and youth ages, which may have transfer to improve other sports-type abilities, improvement of bone health, as it favors an increase in density and mineral content osseous. Regular practice in physical-sports activities with body weight support in general, and with a high content of force actions in particular, are powerful osteogenic stimuli. It also produces improvements in body composition and insulin sensitivity.

Currently it is not possible to establish or recommend a chronological age as optimal or minimum for the start of strength training, since we can find differences in biological maturity between children of the same sex and age. There is no known optimal combination or dose of the components or variables of the load in the child athlete, the general recommendation for child athletes who start strength training is 2-3 sessions a week on non-consecutive days, which will allow adequate recovery between sessions while being an effective frequency to improve strength.

Regarding volume, the number of exercises per training session, there should be a balanced distribution for the whole body, it is recommended to do 3-8 exercises per session according to the characteristics of the exercises. According to intensity, the recommendation for child athletes is that those who start use resistance lower than or close to 60% of the maximum repetition. The American College of Sports Medicine (American College of Sport Medicine) recommends that strength training in the child athletes should be practiced twice a week.

The means for the initiation of strength training have proven to be effective, among them the most used are the own body weight, elastic bands, adapted variable resistance machines, free weights, manual resistance and medicine balls.

Positioning of the use of strength training in the child athlete

Currently there is notable disagreement regarding planning in training with children. Diverse positions for or against are common and unfortunately place the sports coach teacher in a very compromising situation. Four positions regarding periodic and cyclical planning in training with children are clearly distinguishable [10].

- Feige, 1982, exposes a resounding no to the organization of temporary structures, because it is assumed that they define a context of rigidity and demand such that they go against the needs and interests of children, because they induce premature exhaustion of the performance capacity, the aptitude and the interests of the child, the rhythm and degree of adaptation, preparation and recovery and because it has not been possible to verify that the young organism can withstand performance training without risks for the osteomyoarticular system.

- The second position shows the possibility of flexibly employing the organization of training for temporary periods, following the guidelines of periodic planning, based on the principles of Matveev, matching the training periods (preparatory, competitive and transitory) with the process pedagogical, the biological process and respecting in such planning the children's vacation cycles.

- The third position has no reservations when stating that the basic principles of periodic planning considering the need to take into account the sensitive phases, when developing some elements around the "organization and contents of athletics work in children's sports schools . The stages that are considered in the training of the athlete are: the basic preparation stage, the early specialization stage, the intensive training stage and the sports improvement stage.

- Regarding the fourth position, we believe that there are emerging proposals worthy of consideration, such as those presented by Uribe Pareja (1997), who, developing ideas by Pierre Parlebas, considers it vital to take into account socio-motor, physical-motor, perceptual-motor objectives, in addition, training in knowledge of motor behavior, in relationships and norms, in caring for the body, cooperation, and in understanding social and cultural phenomena.10

Among the general guidelines for strength training in children and adolescents is; Carrying out an adequate pre-participatory evaluation is one of the essential conditions to start physical activity, it is necessary to develop supervision, instruction and qualified or instructed teaching, always guaranteeing a safe and risk-free environment, preferably after postural control is acquired around 7-8 years, it is suggested to start with 2-3 sessions per week on non-consecutive days, which can last from 20 to 30 minutes, always start the activity in each session with aerobic work and dynamic warm-up of 5 to 10 minutes Teaching the technique with adequate methodological progressions, adapted to the possibilities of the subject, is an inviolable guideline for this type of training and is considered a priority of the sports coach teacher [11].

Conclusions

The effectiveness, benefits and risks of strength training have been little studied in child athletes, the changes in tension in different areas of the periosteum and the physis can be a factor that leads to increased growth in certain bone portions. Regular practice in physical-sports activities with body weight support in general, and with a high content of force actions in particular, are powerful osteogenicstimuli.Among the general guidelines of strength training in child athletes is an adequate preseason evaluation, supervision, instruction and qualified teaching ensuring a safe and risk-free environment.

Conflict of Interests

The authors of this article declare that they have no conflict of interest whatsoever with the objectives of the research.

Contributions from the authors. Participation and contributions to the work

- Dr. Leonardo MartínezAparicio. He performed a bibliographic review, the analysis of the results and wrote the first version of the manuscript.

- Dr. C. Lázaro Martín Martínez Estupiñán. He designed the study, collected the sample, analyzed the results, and wrote the first version of the manuscript.

- Dr. Luis Bretón Espinosa. Analyzed the results. Final review of the work.

Dr. Juan Carlos Cedré González. Analyzed the results. Final review of the work.

Dr. Ernesto IbañezZamora.Analyzed the results. Final review of the work.

References

1. Martínez Estupiñán LM, Martínez Aparicio L, Martínez Aparicio L, Morales Piñeiro S, Mata Cuevas R. (2019). Inyección de aceite en los miembros superiores con fines estéticos. Acta Médica del Centro. 13(4).
2. Lloyd RS, Faigenbaum AD, Stone MH, et al. (2014). Posicionamiento sobre el entrenamiento de fuerza en jóvenes. Consenso Internacional de 2014. ArchMed Deporte 31(2): 111-124.
3. Ratel S High-intensity and resistance training and elite young athletes. (2011). Med Sport Sci. 56: 84-96.
4. Peña G, Heredia JR,LloretC,Martín M, Da Silva-Grigoletto ME. (2016). Iniciación al entrenamiento de fuerza en edades tempranas: revisión.Revista Andaluza de Medicina del Deporte. 9(1): 41-49.
5. Falk B, Tenenbaum G. (2015). La Efectividad del Entrenamiento de la Fuerza en los Niños. Un Meta-Análisis.Revista de Educación Física. 32(3).
6. Paola Angelina Martínez Miranda PA, Fajardo Trejo LV, Berlioz Gutiérrez CE. Enfermedad de Osgood-Schlatter. (2019). Revista Cubana de Ortopedia y Traumatología 32(1): 158.
7. Bonilla Ugalde P. Chavarría Briceño M. (2016). Grajales Navarrete C. Tendinitis rotuliana (Rodilla del saltador). Revista Médica de Costa Rica y Centroamérica LXXIII. 620: 519-523.
8. Francisco Verdugo M. (2015). El proceso de maduración biológica y el rendimiento deportivo. RevChilPediatr. 86(6). 383-385.
9. Conde CortabitarteI. (2016). Beneficios del entrenamiento de la fuerza en Educación Primaria. Magister. 28: 94-101. http://dx.doi.org/10.1016/j.magis.2016.10.001
10. Ramos Bermúdez S, TabordaChaurra J. (2019). Orientaciones para la planificación del entrenamiento con niños. Educación Física y Deportes. 65: 45-52.
11. Comité Nacional de Medicina del Deporte Infanto juvenil. (2018). Entrenamiento de la fuerza en niños y adolescentes: beneficios, riesgos y recomendaciones.Arch Argent Pediatr. 116 5): 82-91.