体能训练理论与方法

Physical training theory and methods

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东京奥运周期的体能训练
Physical training of the Tokyo Olympic cycle



UFC体能训练
Physical training of the UFC



当前体能训练的重大变革

Current major changes in physical training

- 在理念上，提出了“动作”就是竞技。从能力增长和预防损伤两个层面提出了“动作”是技术的本源，“姿态”是技术能力最基本的体现；

Conceptually, it is proposed that "movement" is competition. At the level of ability growth and injury prevention, it is proposed that "movement" is the origin of technique, and "posture" is the most basic manifestation of technical ability;

- 在理论上，提出了人体“核心区”的概念，“核心稳定”是传递、整合和控制力量的关键；

Theoretically, the concept of the “core” of the human body has been proposed, and “core stabilization” is the key to transmitting, integrating and controlling strength;

- 在方法上，给出了与传统力量训练不同的训练手段、原则和要求。

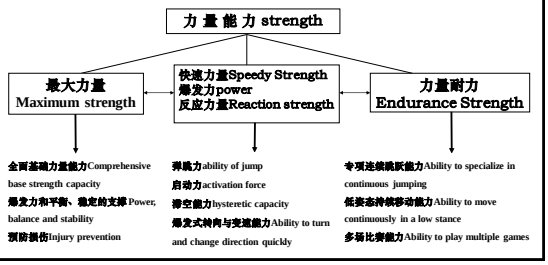
Methodologically, training tools, principles and requirements are given that differ from traditional strength training.

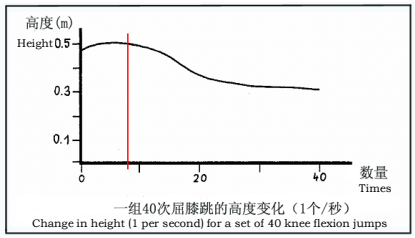
内容
Contents

1. 爆发力 Power
2. 有氧耐力 Aerobic endurance
3. 平衡稳定 Balance and stability
4. 柔韧性 Flexibility

一、体能训练：爆发力
Physical training: Power

武术运动员的力量能力结构 Structure of Strength Capacity in Wushu Athletes

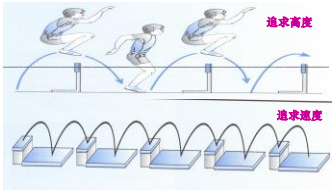




一组40次屈膝跳的高度变化（1个/秒）
Change in height (1 per second) for a set of 40 knee flexion jumps

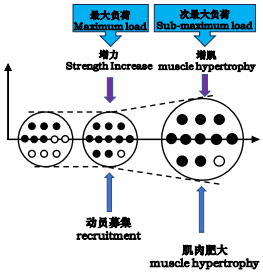
生物学机理Biological mechanism
- 神经反射募集Nerve Reflex Recruitment
- 弹性能量转换Elastic energy conversion

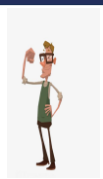
关键条件Key conditions
- 踏跳时间Step time
  - < 90 ms
  - 90-250 ms
  - > 250 ms



速度对人体运动具有重要作用Speed plays an important role in human movement

项目Sports	时间 Time
跳深 Drop jump	◆各类短距离项目Various short distance sports;
深跳深 Deep Drop jump	◆各种球类项目；Various ball games sports;
跳远起跳 Long jump	◆格斗类项目Fighting sports;
短跑 Sprit	◆爆发力项目Explosive power sports.
跨步跳 Bound	
格子跳 checkered jump	160 ms





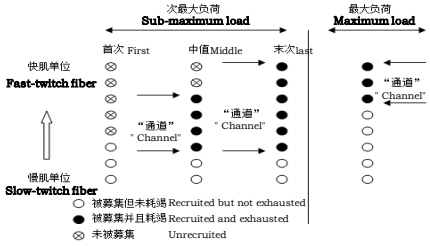
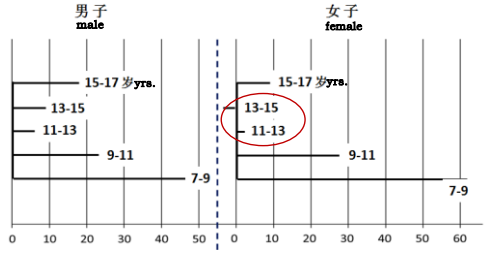


图 3 不同运动单位训练效果示意图 （根据 Zatsiorsky）
Figure 3 Schematic of the effects of different motor unit training (according to Zatsiorsky)



不同年龄青少年变向跑成绩提高相对值（%）

The relative Improvement value of changing direction running performance of Adolescents of different ages (%)

带离心勾的卧推Bench press with centrifugal hook

基于速度的力量训练Velocity-based training (VBT)

六角杠铃硬拉deadlift with hexagonal barbell

弹力带阻力纵跳Vertical jump with elastic-band resistance

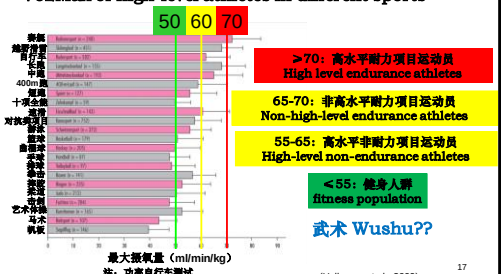
自重连续跳跃Drop jump continuously

高心飞轮保加利亚蹲Bulgarian Squat with Centrifugal Wheel

二、体能训练：有氧耐力
Physical Training: Aerobic Endurance

武术项目的比赛时长
Duration of competitions in Wushu competitions

项目 sports	套路 Wushu Routine		
	枪、剑、刀、棍、南拳、南刀、南棍 Spear, sword, broadsword, Staff, southern fist, southern sword, southern Staff	对练 Face-to-face Training	太极拳、太极剑 Tai Chi, Tai Chi Sword
时间/s times/s	80-120	40-120	180-240



(Hollmann et al., 2009)

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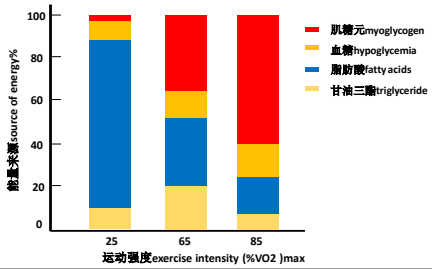
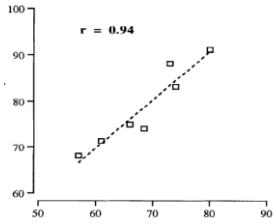
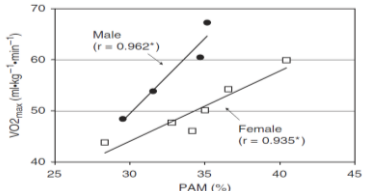


有氧能力与CP合成的关系
Relationship between aerobic capacity and CP synthesis



%VO2max at 4mm blood lactate (Bogdanis et al. 1996)

VO_{2max}与篮球模拟比赛中的运动时间比
Ratio of VO_{2max} to movement time in a simulated basketball game



运动时间比:比赛中跑动和跳跃所用时间占总时间的百分比

Motion Time Ratio: Percentage of total time spent running and jumping during a match.

(Narazaki et al. 2008)

高强度间歇训练 （HIIT） 和速度间歇训练（SIT）的主要作用
The main effects of (HIIT) and speed interval training (SIT)

1、提升CPr和糖酵解无氧能力；

Improve CPr and glycolysis anaerobic capacity;

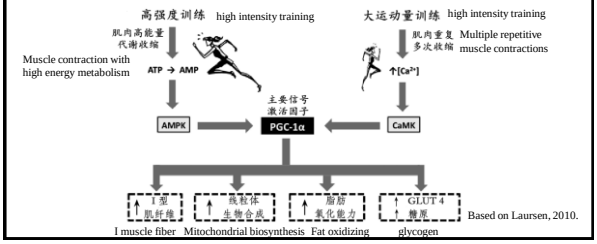
2、提升或保持有氧能力；

Improve or maintain aerobic capacity;

3、减脂作用。

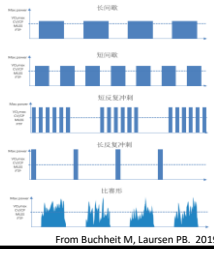
Fat-reducing effect.

基于分子水平的高强度和大运动量训练对人体竞技能力的影响
Effects of high-intensity and high-volume training on human athletic performance based on the molecular level



Based on Laursen, 2010.

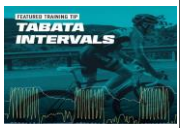
高强度间歇训练分类
Classification of High Intensity Interval Training



From Buchheit M, Laursen PB. 2019

- HIIT可分为两大类：高强度间歇训练（HIIT）和速度高强度间歇训练（SIT）。日本人还创造了Tabata训练，是SIT的一种类型。
  HIIT can be divided into two main categories: High Intensity Interval Training (HIIT) and Speed High Intensity Interval Training (SIT). The Japanese have also created Tabata training, a type of SIT.
- 根据运动强度、持续时间、恢复强度和恢复时间这四个关键因素，可将HIIT分为长间歇、短间歇、短重复、长重复和比赛强度五种HIIT类别。HIIT can be categorized into five categories - long intervals, short intervals, short repetitions, long repetitions, and competition intensity - based on four key factors: exercise intensity, duration, recovery intensity, and recovery time.

Tabata



- 谁发明的Tabata训练？ Who invented Tabata training?

  日本的Izumi Tabata博士在1996年提出。Dr.Izumi Tabata of Japan introduced it in 1996.

- 什么是Tabata训练？ What is Tabata Training?

  8组×（20s高强度训练+10s主动/被动恢复）共4min训练。8 sets × (20s high intensity training + 10s active/passive recovery) for 4 min.

- Tabata训练具有哪些功效？ What are the effects of Tabata training?

  提高不同人群的有氧能力和无氧能力，并具有改善糖脂代谢和体成分的功效。It improves aerobic and anaerobic capacity in different people and has the effect of improving glycolipid metabolism and body composition.

(Tabata, 2019 Foster, 2015 Tabata, 1996)

三、体能训练：平衡、稳定
Physical Training: Balance and stability


弓步forward Lunge

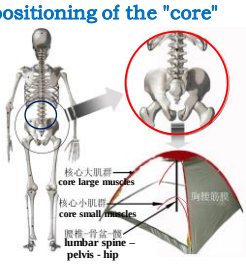

仆步crouching step


马步horse stance

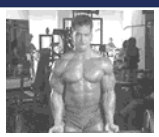

虚步empty step


歇步rest-stand step

“核心”的重新定位 Repositioning of the "core"



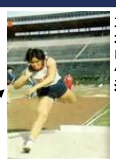
核心稳定性的构成及其相互关系
Components of core stability and their interrelationships



重心的稳定与变换
Stabilization and transformation of the center of gravity

核心
Core

力量的传递
Transmission of Strength



力量的控制
Control of strength

力量的整合
Integration of strength

FMS测试
FMS test

◆评价平衡性和对称性
Evaluating balance and symmetry
◆评价灵活性和稳定性
Evaluation of flexibility and stability
◆建立基本动作模式和控制
Establish basic movement patterns and controls

核心力量的主要训练方法The main training methods for core strength


绳索训练rope training


振动杆训练flexi-bar training


药球训练medicine ball training


振动训练Vibration training


瑞士球训练Swiss ball training


滑板训练Skateboard training


不稳定力量训练Unstable Strength Training


稳定性训练Stability training

核心力量的主要训练方法 The main training methods for core strength


鸟狗式alternating bird dog


俄罗斯转体Russian twist


平板撑上推plank step-up


瑞士仰卧屈膝提臀hip raise


交叉摸膝卷腹cross crunch


仰卧交替触踵alternating heel touch

四、体能训练：柔韧
Physical Training: flexibility

拉伸分类：Stretching Classification

根据施力方式
Based on the type of force applied
- 主动拉伸Active stretching
- 被动拉伸passive stretching
- 辅助拉伸Assisted stretching

根据动作特征
Based on the movement characteristics
- 静态拉伸Static Stretching
- 动态拉伸Dynamic Stretching
- PNF拉伸 PNF Stretching
- 弹震式拉Ballistic Stretching
- 主动分离式拉伸 Active Isolated Stretching

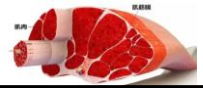
拉伸对运动表现的影响 Effects of stretching on performance

1. 提升关节活动度
   Increases joint mobility ↑
2. 增加肌肉和肌腱弹性
   Increases muscle d tendon elasticity ↑
3. 降低骨骼肌损伤风险
   Reduces risk of skeletal muscle injury ↓
4. 提高运动表现能力
   Improve athletic performance ↑

影响拉伸效果的主要因素
The main factors affecting the stretching

1. 肌肉温度 Muscle temperature
2. 骨骼肌与韧带的伸展性 Stretching of skeletal muscles and ligaments
3. 关节结构特征 Structural features of the joint
4. 中枢神经系统协调能力 Central nervous system coordination capacity
5. 牵张反射与反/逆牵张反射 Myotatic reflex and anti/reverse
6. 交互抑制作用 Reciprocal inhibition
7. 其他因素：年龄、性别、运动水平等
   Other factors: Age, Gender, Level of exercise, etc.

拉伸拉的是什么？What does stretching pull?



□事实上，拉伸拉的并不是拉「韧带」。
In fact, it is not the 'ligaments' that stretching pulls.

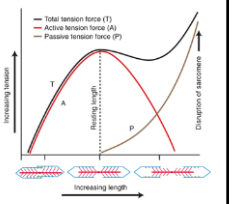
□韧带拉开后会导致关节稳定性降低、增加受伤的风险，因此，**拉伸的不是韧带，拉的是肌肉和肌肉的筋膜。**
Stretched ligaments can lead to decreased joint stability and increased risk of injury, so it's not the ligaments that are stretched, it's the muscles and myofascia that are stretched.

□筋膜是贯穿身体的一层结缔组织，它包绕着肌肉、肌群、血管和神经。
Fascia is a layer of connective tissue that surrounds muscles, muscle groups, blood vessels and nerves.

为什么静态拉伸会削弱肌力？
Why Static Stretching Weakens Muscle Strength ?

□ 神经假说 Neurological hypothesis
神经因素参与了牵拉所致的肌无力，这导致肌肉激活和反射敏感性降低（换句话说，肌肉收缩受到抑制）。Neurological factors are involved in pull-induced muscle weakness, which results in reduced muscle activation and reflex sensitivity (in other words, muscle contraction is inhibited).

□ 机械假说 Mechanical hypothesis
机械因素导致了肌腱单元的刚度下降，通过长度-张力关系影响了肌肉的力量。肌肉可以产生的主动收缩力在静止时最大，但如果缩短或延长肌肉，则收缩力会降低。静态拉伸后，肌肉腱单元的刚度降低可能会增加横桥的静止长度，进而改变长度-张力关系，从而降低肌肉的最大产生力的能力。Mechanical factors lead to a decrease in the stiffness of the tendon unit, which affects the force of the muscle through the length-tension relationship. The active contractile force that can be generated by a muscle is greatest at rest, but is reduced if the muscle is shortened or lengthened. After static stretching, the reduced stiffness of the muscle tendon unit may increase the resting length of the transverse bridge, which in turn alters the length-tension relationship and thus reduces the muscle's ability to maximize force production.



改变长度-张力关系，从而降低肌肉的最大产生力的能力
Altering the length-tension relationship, thereby reducing the muscle's ability to maximize force production

肌梭muscle spindle

刺激Stimulus：动态拉伸 dynamic stretching

反应Response:
1.肌肉被牵拉时快速收缩
rapid contraction when muscle is pulled

2.抑制拮抗肌的张力
inhibits tension in antagonistic muscles

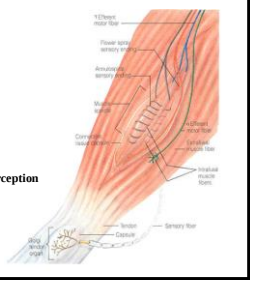
高尔基腱器官 Golgi tendon organ

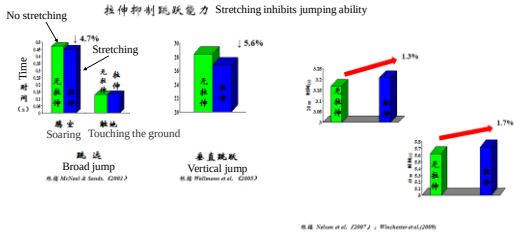
刺激Stimulus：在大幅度肌肉拉伸过程中感受肌肉张力perception of muscle tone during large muscle stretches

反应Response：

1. 抑制肌肉过分拉伸 inhibits excessive muscle stretching

2. 反射性引起肌肉舒张reflexively induces muscle diastole





PNF

1. 从被动的预拉伸开始，在轻微的不适点保持10秒。Start with a passive pre-stretch and hold for 10 seconds at the point of mild discomfort.

2. 然后，搭档施加髋部屈曲力，指导运动员：“保持住，不要让我推动腿”;运动员保持和抵抗推力，使肌肉做等长收缩，并保持6秒。 The partner then applies a hip flexion force and instructs the athlete: “hold it, don’t let me push the leg”; the athlete holds and resists the push, causing the muscle to make an isometric contraction and holds for 6 seconds.

3. 然后运动员放松，进行进一步被动拉伸并保持30秒。The athlete then relaxes and performs a further passive stretch and holds for 30 seconds.

➢ 由于自身抑制的作用，最后的伸展幅度应该更大。 The final stretch should be greater due to self-inhibition

当前运动训练的新模式、新理论和新方法
Current new modes, theories and methods in athletic training

模式 Mode

- “三位一体”训练模式 “Trinity” training mode
- 基于生物学新技术的实验室训练 Laboratory training based on new biological techniques
- 科学化训练团队 Scientific training team

理论 Theory

- 耐力的乳酸阈和两极化训练理论 Lactate threshold and polarized training theory of endurance
- 基于生物学的专项运动特征及其训练 Biologically based characteristics and training of specific sports
- 急性-慢性负荷率 Acute-chronic load rate
- 跨界跨项目选材 Talent transfer selection
- 体能训练 Strength and conditioning training
- 冠军模型 Champion model

方法 Method

- 高强度间歇训练（HIIT,SIT） High-intensity interval training
- 血流限断训练（BFRT） Blood flow restriction training
- 课主观疲劳感（s-RPE） Session RPE
- 经颅电刺激（tES） Transcranial electric stimulation
- 被活后增强效应（PAP） Post-activation potentiation
- 双侧力亏损（BFD） Bilateral force deficit
- 躯干力量训练 Trunk strength training
- 拉伸训练 Stretch training
- 脑适能训练 Brain fitness training
- ……

训练和监控方法的创新与科学基础的提升 Innovations in training and monitoring methods and enhancement of the scientific base

血流阻断训练(blood flow restriction（BFR）

经颅直流电刺激Transcranial direct current stimulation （tDCS）

中华武术的发展
Development of Chinese Martial Arts

1. 加强传统武术思想的挖掘、梳理和提炼；
   Enhance the mining, sorting and refining of traditional martial arts ideas;
2. 运用现代科学方法对武术进行深入研究；
   To conduct in-depth research on Wushu using modern scientific methods;
3. 构建基于中国武术思想和方法的训练理论。
   Construction of training theories based on Chinese Wushu ideas and methods.

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