Jump Training: ¿Why and How?: an Exhaustive Review
Biological Adaptations with Jump Training

Rodrigo Ramírez-Campillo
Department of Physical Activity Sciences
Research Nucleus in Health, Physical Activity and Sport
Laboratory of Measurement and Assessment in Sports (LabMED)
University of Los Lagos, Osorno, Chile
Bone Adaptations

JT may implicate GRF up to 7 times body mass


**Type of Study:**
Review and meta Analysis.

**Subjects**
Females (from childhood to older age participants)

**Methods:**
Data base research from 2009 to 2015, English.
12 studies (from 973) meet inclusion criteria.

**Results:**
Impact exercises + RT are a key combination to improve/maintain bone health in pre and postmenopausal females.
At childhood, bone health can be improved with brief training sessions (10-20 min), incorporating high impact jumps (applied in schools).

**Interpretation:**
With a modification in the impact level according to age, JT exercises may positively affect bone health in females.
50-100 jumps/session.

3 – 5 sessions/wk.

5 - 24 months.

1% – 8% increase bone mass/density in youths (> effect at younger ages).

1% - 4% in adults.

> Increase at some anatomical sites (i.e., femoral neck).

Increased mass, density, structure (geometry), strength.

Effects last for longer periods (i.e., reduced detraining effect).
Although there is no consensus among studies, usually adaptations (if they occur) take place after 6-15 weeks.

> Elongation of Achilles tendon and elastic energy accumulation + CMJ performance

> Stiffness in Achilles tendon and accumulation-release of elastic energy.
> Jump performance.

> 29% stiffness in Achilles tendon + Muscular concentric-explosive performance

Increased stiffness in plantar flexors and CMJ.

Increased ankle stiffness.
Stiffness increase may be greater in fast muscle fibers.


In addition, stiffness increase may be greater in bi-articular muscles (e.g. gastrocnemius).

Therefore.....

.....JT may induce adaptations in the muscle-tendon complex in the short-term.

Fast muscle fibers may achieve greater stiffness adaptations with JT.

However, performance increases is not always related to muscle-tendon complex adaptations.
Adaptations in Muscle Fiber Type

Increased % of IIa in vastus lateralis.

Combined with RT, an increase in Type IIa muscle fibers was observed in vastus lateralis.......... 

....however, several studies have reported contrasting results.....therefore, human studies are not conclusive.

In animals (i.e., soleus rat muscle) seems to be consensus in that JT may increase the % of Type II muscle fibers.
Muscle and Isolated Fibers Contractil Performance

Type I, IIa y IIx: > maximal force, power and contraction velocity. 
Whole muscle: > maximal force and power.


Plantar flexors: < contraction time after 12 weeks.

Gastrocnemius: > maximal torque, RFD, and < contraction time after 10-wk.

Peak torque

Rate of torque development
**Hipertrophy in Whole Muscle and Isolated Muscle Fibers**

**Plantar flexors > volume (MRI) after 12-wk (similar increase compared to RT)**


---

8-wk of JT induced hypertrophy in vastus lateralis, in fibers type I (23%), type IIa (22%), and type IIa/IIx (30%).


---

**Vastus lateralis: increase in type I and type II muscle fibers (6% – 8%)**


---

**….however, no changes were observed in gastrocnemius.**

Mixed with RT......

......no changes in females.......... 

......but 20% increase in males (fast muscle fibers), with similar training. 

>4% in lean mass in lower body muscles (DEXA). 

Mixed with endurance, vastus lateralis muscle fibers >6% – 7% 
Therefore,

Moderate hypertrophy at short-term (8-12-wk) ¿long-term?

Hypertrophy in muscle fibers type I and type II, although greater in type II.

Lower hypertrophy effect compared to RT.

Greater hypertrophy in knee extensors vs. ankle extensors.

Greater hypertrophy in males vs. females.

…..and these adaptations may be related with acute anabolic effects…..
Acute anabolic effects of JT in youths

Type of study: cross-sectional.

Participants: 26 male youth soccer players; age = 12-14 y.

Methods: 2 randomized protocols (1-wk apart):
30 min RT vs. 30 min JT.

Saliva collected pre-control, post-control, 5 and 30 min post-exercise protocols.

Results: Testosterone increased at 5-min post RT (27% ± 5%) and JT (12% ± 6%).

Interpretation: Although lower than RT, the transient anabolic effect of JT may favor a healthy growth, maturation and development process at youth ages.
Acute increase in IGF-1 after JT

12 females and 8 males
100 jumps with 40% 1RM in sliding leg-press machine
10x10, 2-min of rest between sets.

Muscle geometry may affect muscle strength and power, and may be improved with training.


5-wk, JT + Sprint training

< angle and > length of fascicles in knee extensors + > physical performance.

Adductors: >pre-activation in DJ (intramuscular coordination).
Adductors and abductors: >co-activation in DJ (intermuscular coordination).
These adaptations may reduce injury risk.


An 17% increase in maximal voluntary activation of calf muscles was observed.

>MVC in calf muscles.

> EMG activity in soleus muscle.

Knee extensors >pre-activation during DJ performance.
Excitability changes in myotatic reflex.

Therefore, JT may induce both afferent and efferent neural adaptations.
>actividad muscular isométrica extensores de rodilla


>actividad muscular extensores de rodilla al saltar


Por tanto, el EP, aislado o combinado con RT puede > actividad muscular máxima (o voluntaria), sobre todo en flexores plantares.

El aumento podría explicarse por un > reclutamiento de UM o ritmo de disparo de estas (adaptaciones a nivel descendente).


El EP también podría modificar el patrón de reclutamiento muscular (i.e. coordinación intermuscular).

Los cambios de actividad muscular serían superiores al combinar EP + sobrecarga.

La mayoría de las investigaciones han realizado EMG de superficie durante contracciones máximas o saltos.

Debido a que la EMG podría modificarse por cambios en el impulso neural central, hipertrofia, o incluso factores técnicos no fisiológicos, se debe tener cautela al analizar este tipo de estudios.


Futuros estudios en este ámbito deberían utilizar procedimientos de normalización EMG, técnicas de medición de UM aisladas y/o mediciones de respuestas reflejas inducidas (reflejo Hoffman, onda-F).

Sport Performance Adaptations

Vertical jump....
......Horizontal jump......
......Sprint......
......Agility......
......Endurance......
......Flexibility......
......Coordination......
......Strength.....
......Power.....
......Balance......

These adaptations would be reviewed from specific sport-related interventions, including endurance, explosive, team and youth sports.......next week.
Review of the Day
Adaptations Induced by JT

Óseas

Stifness and complejo músculo-tendón

Tipología de fibras musculares esqueléticas

Rendimiento contráctil de fibras aisladas y músculo entero

Hipertrofia (¿producto de efecto anabólico post ejercicio?)

Geometría muscular

Adaptaciones neurales

Adaptaciones rendimiento físico-deportivo
Existen pocos estudios experimentales referentes al análisis de la intensidad de ejercicios pliométricos.

Estos generalmente sugieren el uso de equipos como plataformas de fuerza y EMG para determinar la intensidad, lo cual es poco útil en ámbitos prácticos.

En estos estudios no se aclara cuales ejercicios son de “baja”, “moderada”, “alta”, etc........intensidad.

La intensidad de algunos ejercicios se ha identificado como mayor o menor, dependiendo del parámetro usado para definir INTENSIDAD: RFD concéntrica, RFD excéntrica, fuerza concéntrica máxima, fuerza de impacto, fuerzas articulares (tobillo vs. cadera vs. rodilla), marcadores de daño muscular, EMG, etc.

Claramente este es un área que requiere de mayor investigación, para posteriormente iniciar intervenciones longitudinales.