BALANCE TRAINING EFFECT ON BALANCE MAINTENANCE
BIOMECHANICAL PARAMETERS DURING SINGLE LEG STANDING
ON A WOBBLE BOARD

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Sports sciences describes postural balance as the ability to maintain the body’s center of gravity (CoG) over the body’s base of support.

Why is it important?

Component of sport techniques

Lack of balance risk factor for sustaining injuries
Beynnon et al., 2002; Willems et al., 2005; Trojan et al., 2006; Dallinga et al., 2012

Protective factor against recurrence of sport injury, especially ankle sprain
Cumps et al., 2007; Emery et al., 2007; Mohammadi et al., 2007; MacLeod, 2008; Hübscher et al., 2010

Different strategies to sustain balance depending on the support surface

- **Firm surface**
  - Ankle strategy

- **Unstable**
  - Ankle + Counter movement + Step Strategies

Otten, 1999; Riemann et al., 2002; Hof, 2007

Wobble boards are effective to increase demands to balance maintenance

How does balance training affect those strategies?

Present study aimed to describe how 4 weeks of balance training affects biomechanical strategies to maintain balance on a WB
20 active males
CAIT score > 28
Hiller et al., 2006
no previous training using WB

Experimental Session

30 seconds - Firm surface (FS) single leg standing

60 seconds - Wobble board single leg standing (WB)

WB standing time duration (WB\_TIME)

3D data - CoG velocity; WB, hip, knee and ankle angular velocity - using rigid body analysis

EMG – Average of rectified value of 12 dominant leg muscles (%FS)

METHODS

Familiarization session

PRE

4 WEEKS

Training Group - Intervention Sessions
Control Group – No intervention

Experimental Sessions

POST

EMG Kinematic Kinetic

EMG

VGRF (N.kg\(^{-1}\))

Velocity (deg.s\(^{-1}\))

Center of Pressure (CoP)

force platform

CoP – FS

EMG 12 dominant leg muscles - normalization purposes

Fz

WBvel

Hiller et al., 2006

force platform
METHODS - Intervention

30 minute sessions

15 WB balance exercises

60 seconds trials with 60 seconds rest

At least 3 trials for each exercise

progressions added once the subjects accomplished to one leg stand still, while keeping board edges off the floor

(Hoffmann et al., 1995; Emery et al., 2007; Clark et al., 2004; Oliveira et al., 2013).
Split Plot Analysis

• 2 Groups (TG, CG)

• Time - PRE and POST - *repeated measures factor*.

  *Interactions Group X Time* significance level p<0.05

• *between subjects factors* - 3 plane of movements (FP, SP and TP)

  12 muscles (SOL, TA, PL, LG, MG, VL, VM, RF, BF, ST, Gmax, GMed)
Balance performance

<table>
<thead>
<tr>
<th>FS</th>
<th>PRE</th>
<th>POST</th>
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<tbody>
<tr>
<td>CG</td>
<td>138.3 (13.0)</td>
<td>121.2 (9.7)</td>
</tr>
<tr>
<td>TG</td>
<td>137.1 (11.6)</td>
<td>116.4 (11.6)</td>
</tr>
<tr>
<td>WB TIME (s)</td>
<td>PRE</td>
<td>POST</td>
</tr>
<tr>
<td>CG</td>
<td>22.1 (3.8)</td>
<td>30.0 (5.3) # †</td>
</tr>
<tr>
<td>TG</td>
<td>16.7 (2.3)</td>
<td>50.1 (3.8) # †</td>
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</tbody>
</table>

76% more increase for TG

FS low demand for this population

(Verhagen et al., 2005; Oliveira et al., 2013)

<table>
<thead>
<tr>
<th>WB velocity (dg.s⁻¹)</th>
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<tbody>
<tr>
<td>Plane</td>
</tr>
<tr>
<td>CG</td>
</tr>
<tr>
<td>FP</td>
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<tr>
<td>SP</td>
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<td>FP</td>
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<td>SP</td>
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<td>TP</td>
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↓ WBVEL

45% FP
56% SP
35% TP

balance can be improved for subjects with no dysfunction

Emery et al., 2005; Gioftsidou et al., 2006; DiStefano et al., 2013

# denotes significant interaction TIME (pre, post) X GROUP (CG, TG); † denotes significant TIME effect
RESULTS AND DISCUSSION

Body Movement Control

CoG

<table>
<thead>
<tr>
<th></th>
<th>FP</th>
<th>SP</th>
<th>TP</th>
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<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
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↓ 65.1% on FP and 48.8% on TP

KNEE

<table>
<thead>
<tr>
<th></th>
<th>FP</th>
<th>SP</th>
<th>TP</th>
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<tbody>
<tr>
<td></td>
<td>5</td>
<td>4</td>
<td>3</td>
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↓ 42.4% on FP 31.8% on SP and 63.7% on TP

HIP

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<thead>
<tr>
<th></th>
<th>FP</th>
<th>SP</th>
<th>TP</th>
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<tbody>
<tr>
<td></td>
<td>20</td>
<td>15</td>
<td>10</td>
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↓ 47% on TP

ANKLE

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<thead>
<tr>
<th></th>
<th>FP</th>
<th>SP</th>
<th>TP</th>
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<tbody>
<tr>
<td></td>
<td>25</td>
<td>20</td>
<td>15</td>
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↓ 54.9% on TP

# denotes significant interaction TIME (pre, post) X GROUP (CG, TG);
CG used **ankle strategy** as an attempt to control the board.

TG used **counter-movement** strategy to control the trunk.

# denotes significant interaction TIME (pre, post) X GROUP (CG, TG); † denotes significant TIME effect
WB balance training

did not affect postural sway for FS

improved balance performance on WB

with higher proximal muscle recruitment in order to control board and body movement

enhanced mechanisms of body control and counter movements

Future investigations on how balance training effects transfer for tasks with high occurrence of sports injuries

THANK YOU FOR YOUR ATTENTION

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