



# Factores de riesgo de lesión

**Asignatura: Readaptación deportiva y reentrenamiento físico-deportivo**

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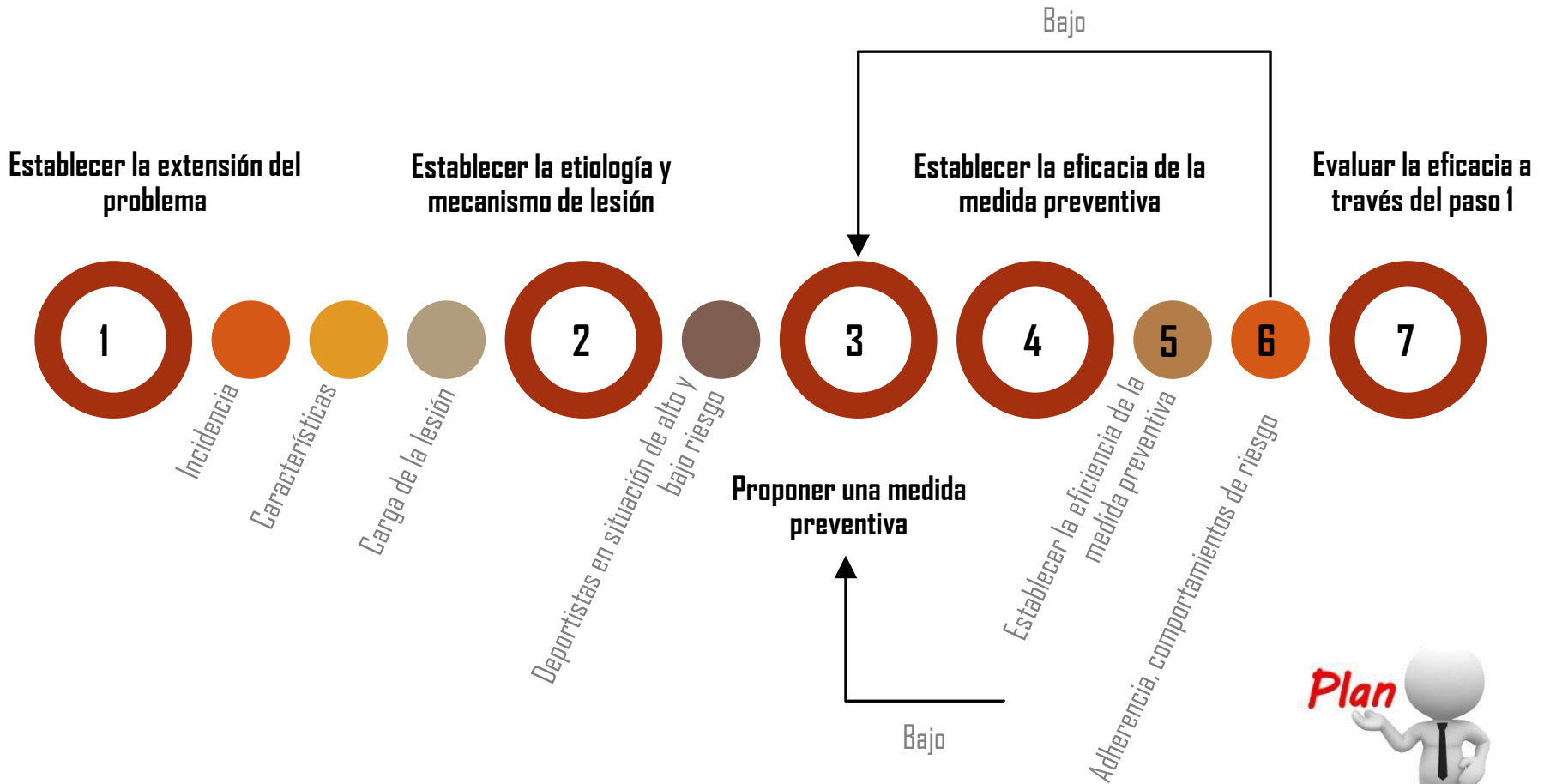
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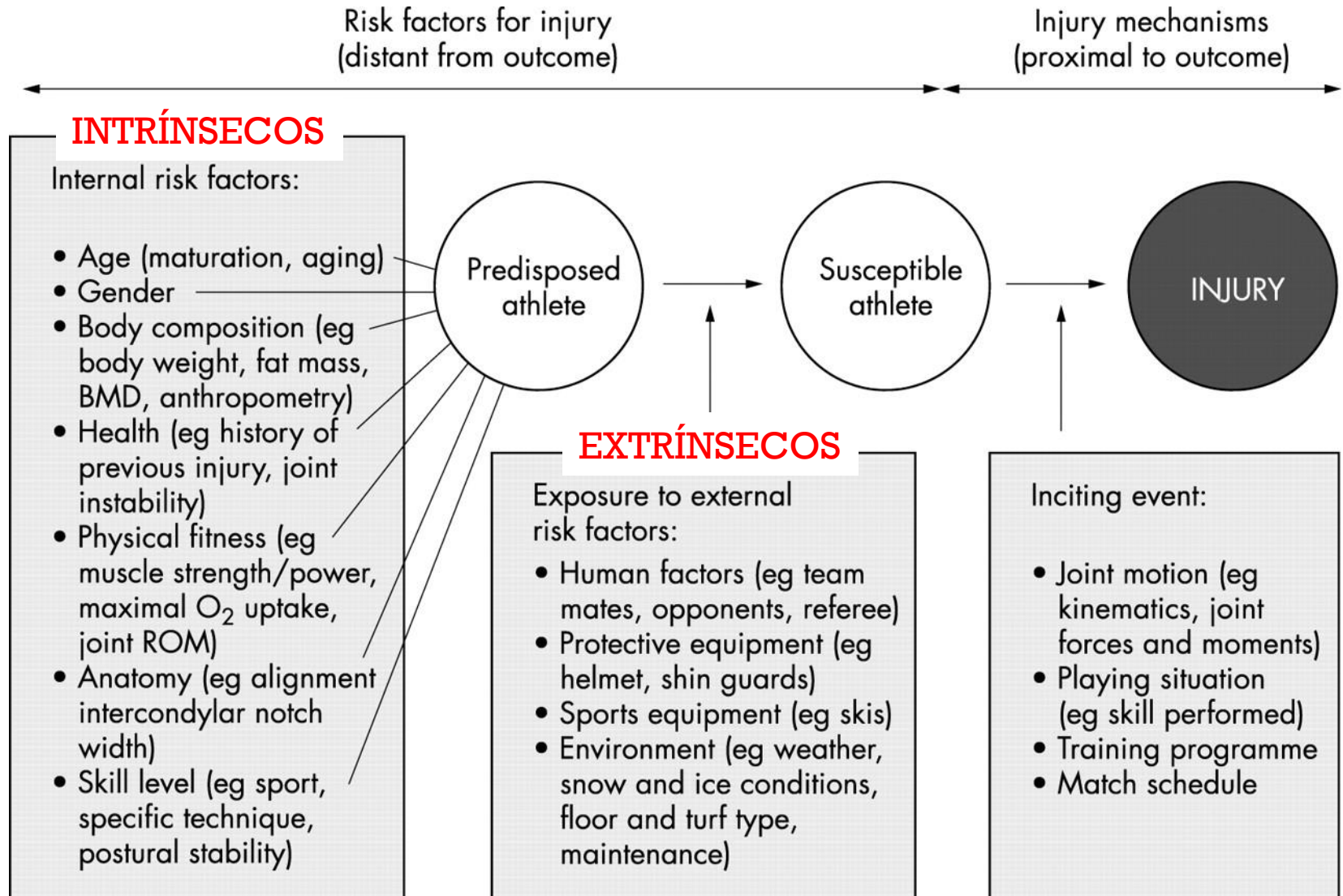


**¿FACTOR DE RIESGO?**

# + CONTEXTUALIZACIÓN

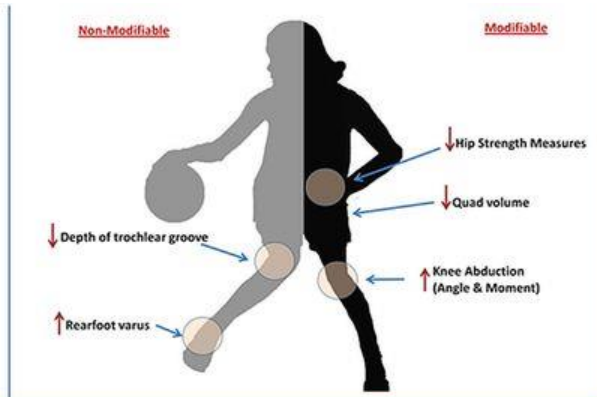
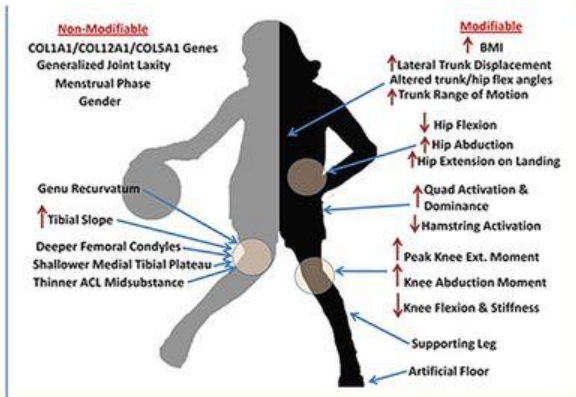


# + CONTEXTUALIZACIÓN

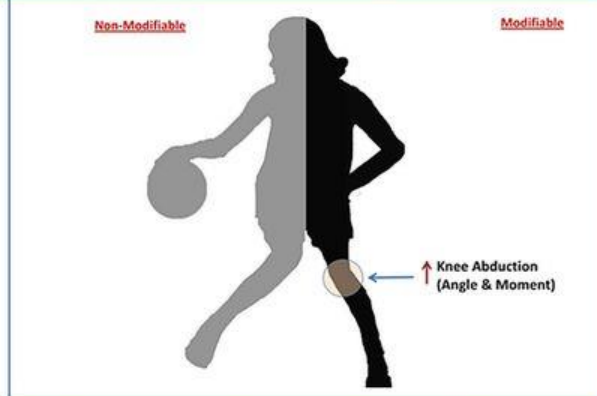
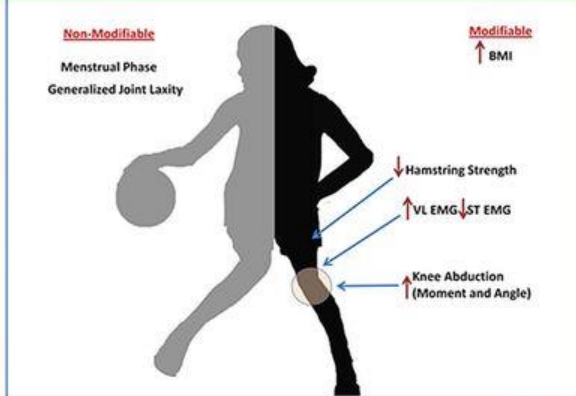
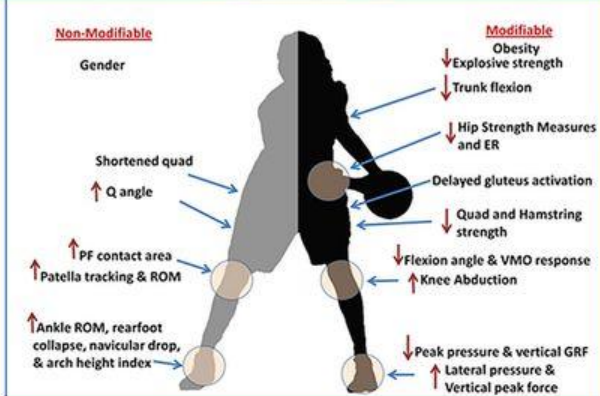


# + CONTEXTUALIZACIÓN

A  
C  
L



P  
F  
P



A. Retrospective investigations which propose ACL/PFP risk factors for merged male and female populations.

B. Retrospective investigations which propose ACL/PFP risk factors for **only female** populations

C. **Prospective** investigations which propose ACL/PFP risk factors for **only female** populations (includes prospective case control).

**“The best evidence from the best research groups in the world cannot come to any agreement of a cause of injury, simply because there are TOO MANY factors involved”**

Dr Joe Warne, Setanta College

Age

Gender

Chance

Coach Decision

Training Load

Body type

Athlete Decision

Time of Season

Training Type

Anatomy

Game Situation

Footwear

Training Surface

Weight/BMI

Match Schedule

Playing Position

Sleep

Skill Level

Joint Stability

Flexibility

Stress

Psychological Factors

Playing Time

Weather Conditions

Opponents

Risk Taking

Health

Fatigue

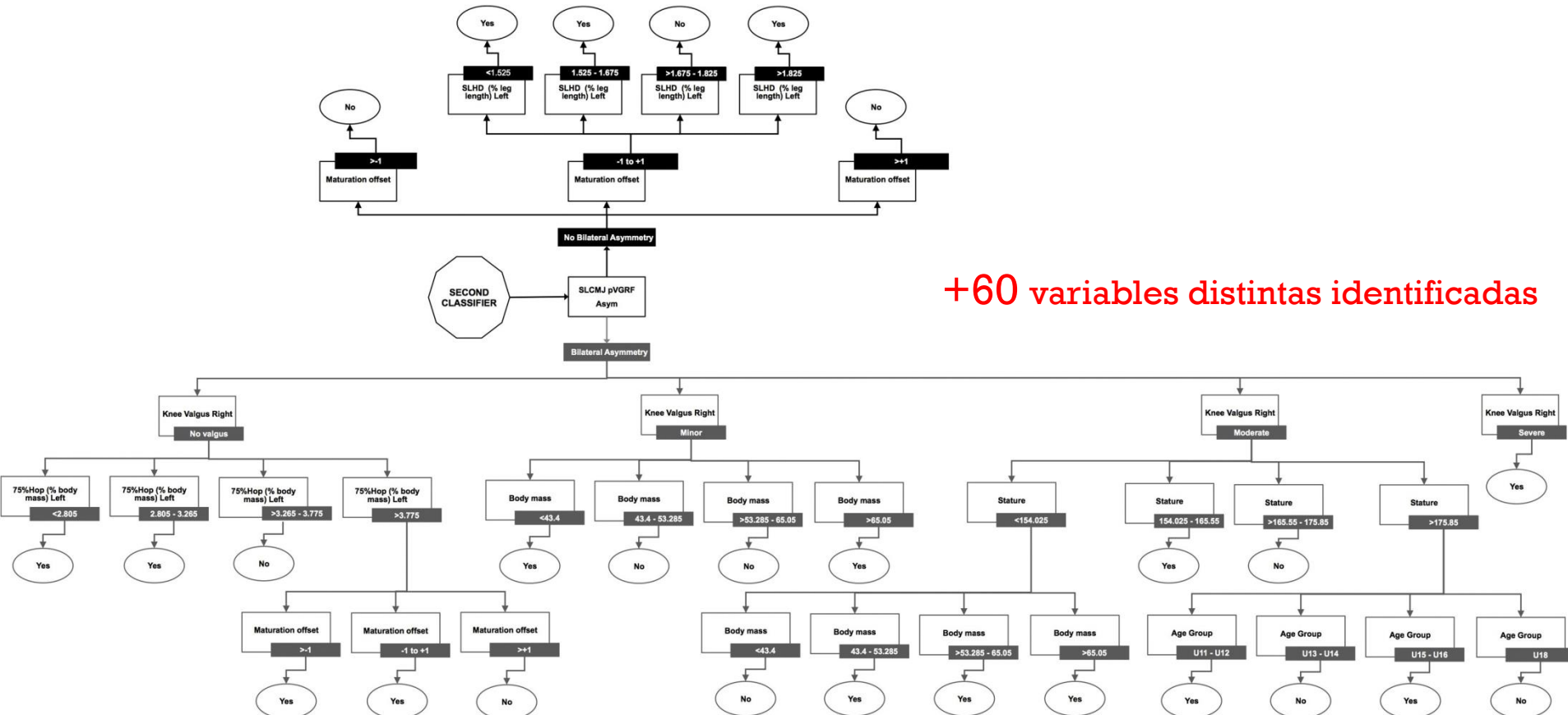
Mood

Biomechanical Factors

Fitness



# CONTEXTUALIZACIÓN



+60 variables distintas identificadas

# + CONTEXTUALIZACIÓN

**PERSONALES**



**NEUROMUSCULARES**



**PSICOLÓGICAS**

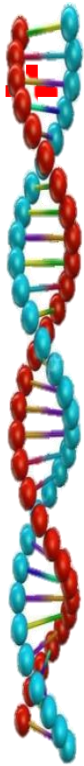






# + VARIABLES PERSONALES

FACTORES DE RIESGO DE LESIÓN



**Edad**



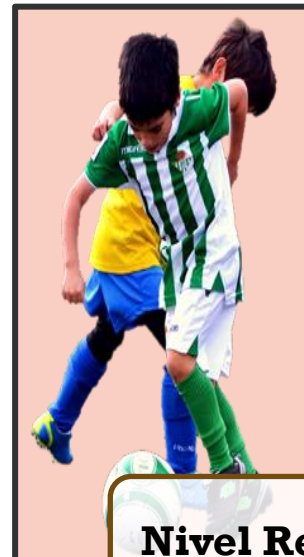
**Sexo**



**Pierna Dominante**



**Composición Corporal**



**Nivel Rendimiento**



FÚTBOL

# Asenjo se rompe el ligamento cruzado de la rodilla izquierda, su cuarta lesión de este tipo

EL PAÍS DEPORTES

FÚTBOL BALONCESTO TENIS CICLISMO FÓRMULA 1 MOTOS GOLF OTROS DEPORTES FOTOS LAS FIRMAS BLOGS TITULARES

LIGA BBVA JORNADA 17 | REAL MADRID - REAL SOCIEDAD

## Canales se rompe el ligamento de la rodilla izquierda

SE ROMPIÓ EL TENDÓN ROTULIANO DE LA RODILLA IZQUIERDA ANTE EL LIVORNO

## Otra lesión rompe a Ronaldo para siempre

## ¡Dembélé, otra vez lesionado!: entre tres y cuatro semanas de baja

LEAGUE AFL FOOTBALL RUGBY NBA CRICKET MMA TENNIS ALL SPORTS MORE

NBA HOME PHOTOS VIDEO BRACKET CHALLENGE SCORES SCHEDULE STANDINGS STATS

## Derrick Rose set for another season-ending knee surgery

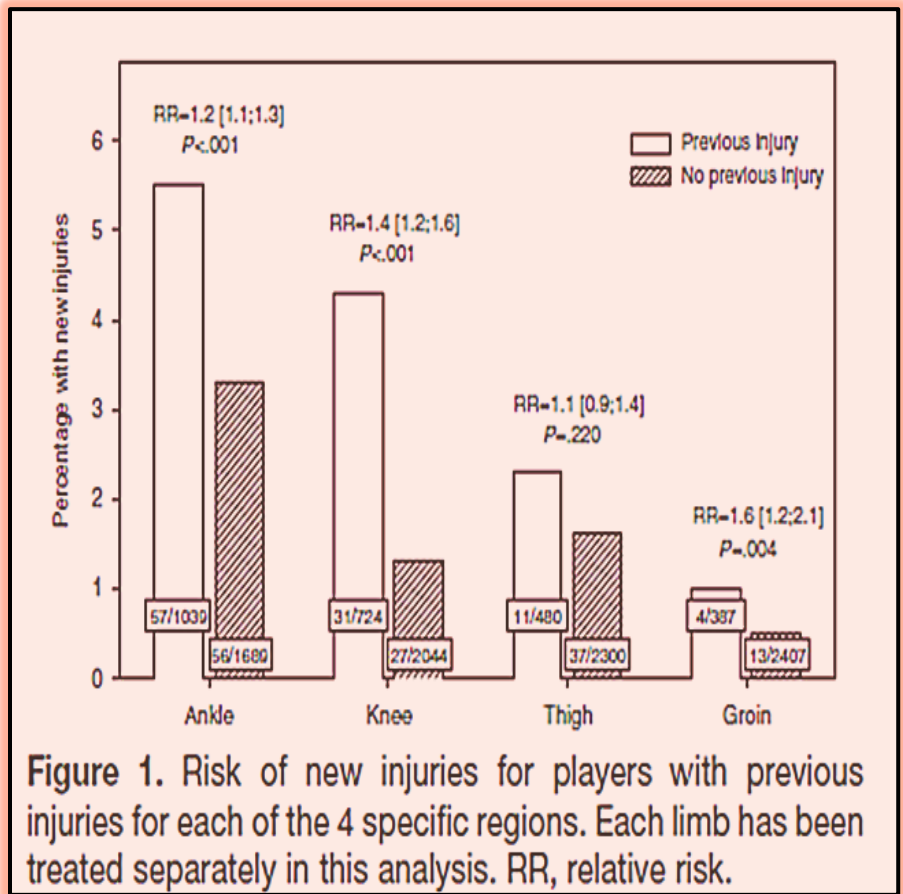
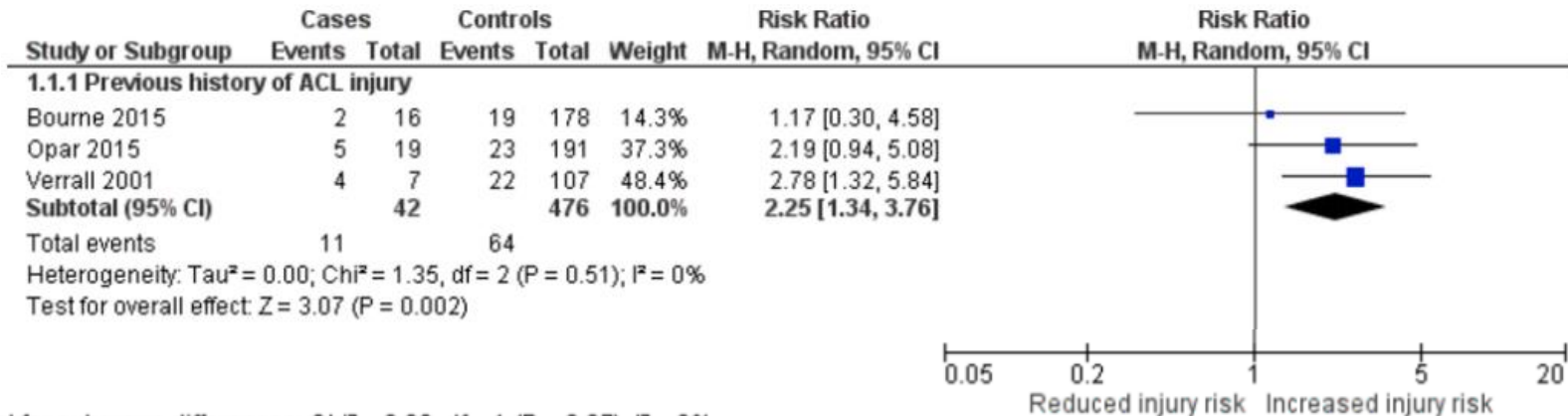


Figure 1. Risk of new injuries for players with previous injuries for each of the 4 specific regions. Each limb has been treated separately in this analysis. RR, relative risk.

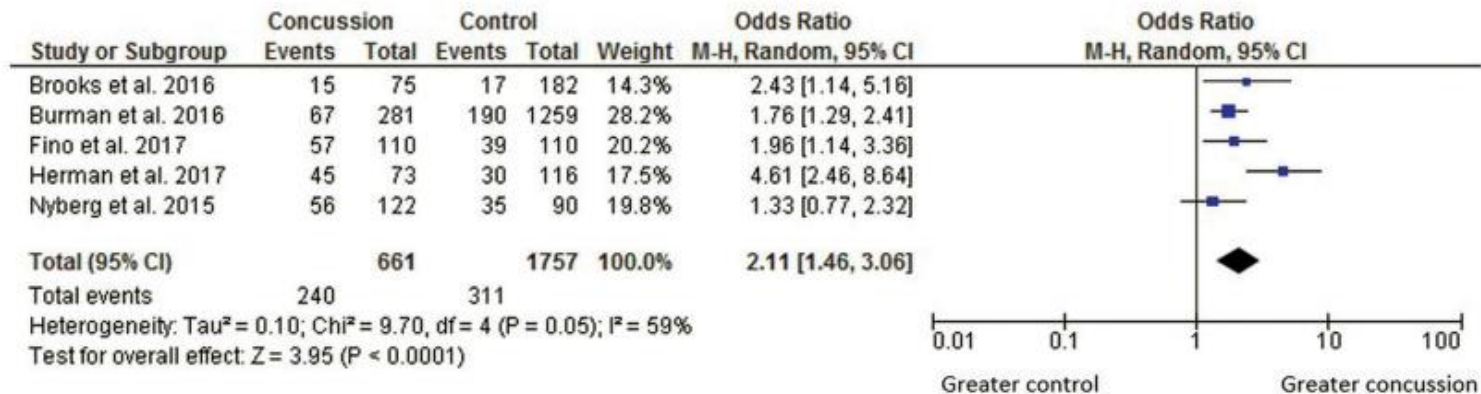
Steffen et al. (2008)



# LESIÓN PREVIA



Test for subgroup differences: Chi<sup>2</sup> = 0.82, df = 1 (P = 0.37), I<sup>2</sup> = 0%



Athletes who had a concussion had 2 times greater odds of sustaining a MSK injury than athletes without concussion. Athletes who had an ACL injury had 2 times greater odds of sustaining a subsequent hamstring injury.



# LESIÓN PREVIA

## CUESTIONARIO AUTORREPORTE



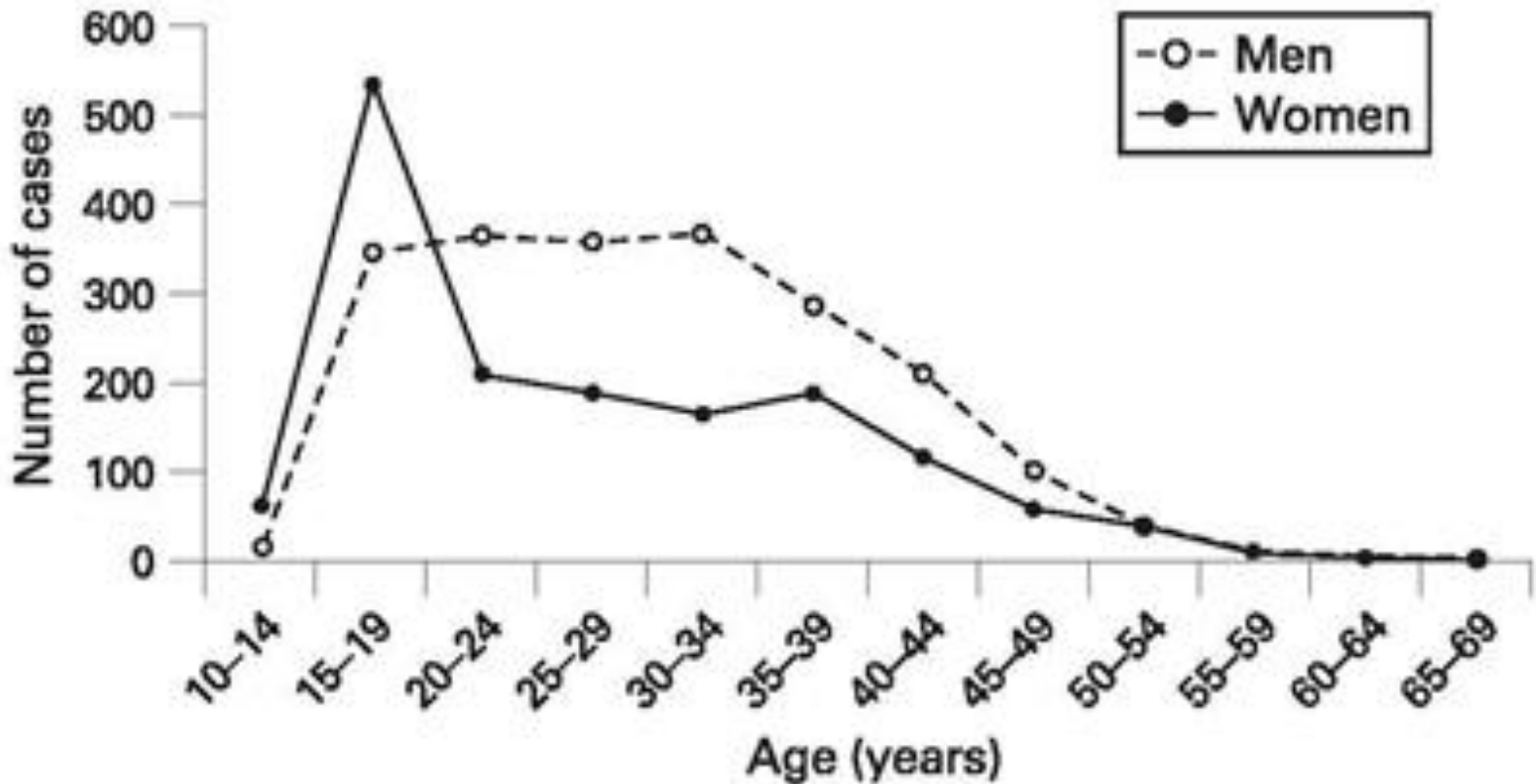
INSTRUCCIONES: Te pedimos que completes este registro sobre las lesiones padecidas la TEMPORADA PASADA.

¿Cuántas lesiones padeciste la temporada pasada?  
Rellena una ficha por cada una de las lesiones padecidas.

LESIÓN N°										
FECHA	¿En qué mes ocurrió?	¿Cuanto tiempo transcurrió hasta que volviste a practicar el deporte sin molestias?		Días	Semanas	Meses				
ZONA (Señalar con una cruz)			TIPO	MUSCULAR	FRAC- TURA/ FISURA	TENDON	CONTUSION	ARTICULAR (esguinces...)	OTRAS (retñar)	
	SITUACIÓN (Marcar el que corresponda)	ENTRENAMIENTO	PARTIDO	OTROS	NO SABE					
	DESCRIPCION DETALLADA DE LA LESION									
PRINCIPALMENTE PRODUCIDA POR	UNO MISMO	ADVERSARIO EN PARTIDO	COMPA- NERO	MATERIAL/EQUI- PAMIENTO	OTROS					
GRAVEDAD (Marcar la que corresponda)										
LIGERA (Cuando requiere de 1-3 días de baja)	LEVE (Cuando requiere de 4- 7 días de baja)	MODERADA (Cuando requiere de 8-28 días de baja)	SEVERA (Cuando requiere más de 28 días de baja)							
AFECTACIÓN A LA PRÁCTICA DEPORTIVA										
¿Cuántos entrenamientos; has perdido a causa de la lesión?	¿Cuántos partidos; has perdido a causa de la lesión?	¿Alguna otra consecuencia producida por la lesión? Describir								
¿A qué atribuyes la lesión?										



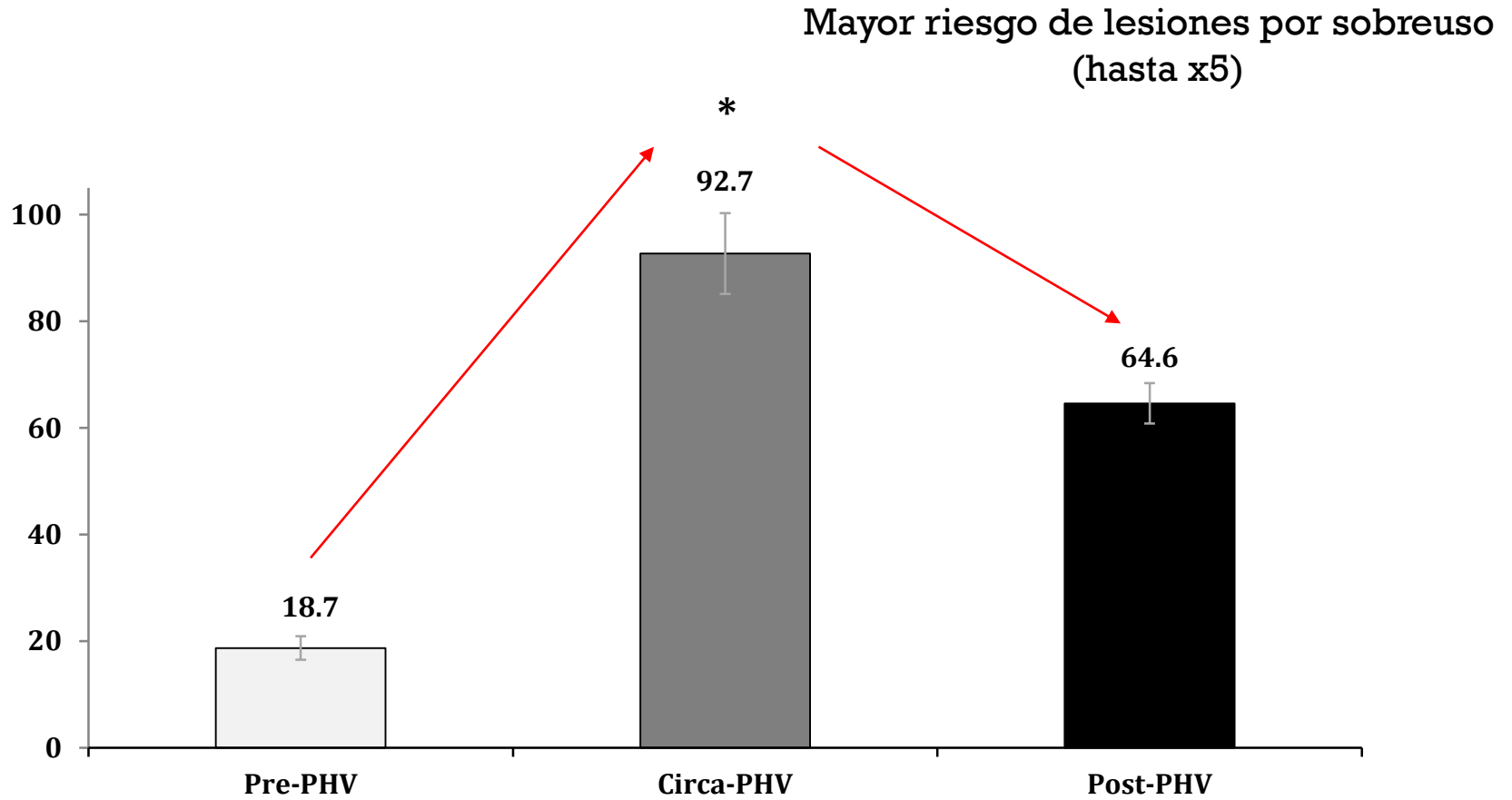
# MADURACIÓN



**Figure 1** Distribution of patients in the Norwegian National Knee Ligament Registry by age and sex.

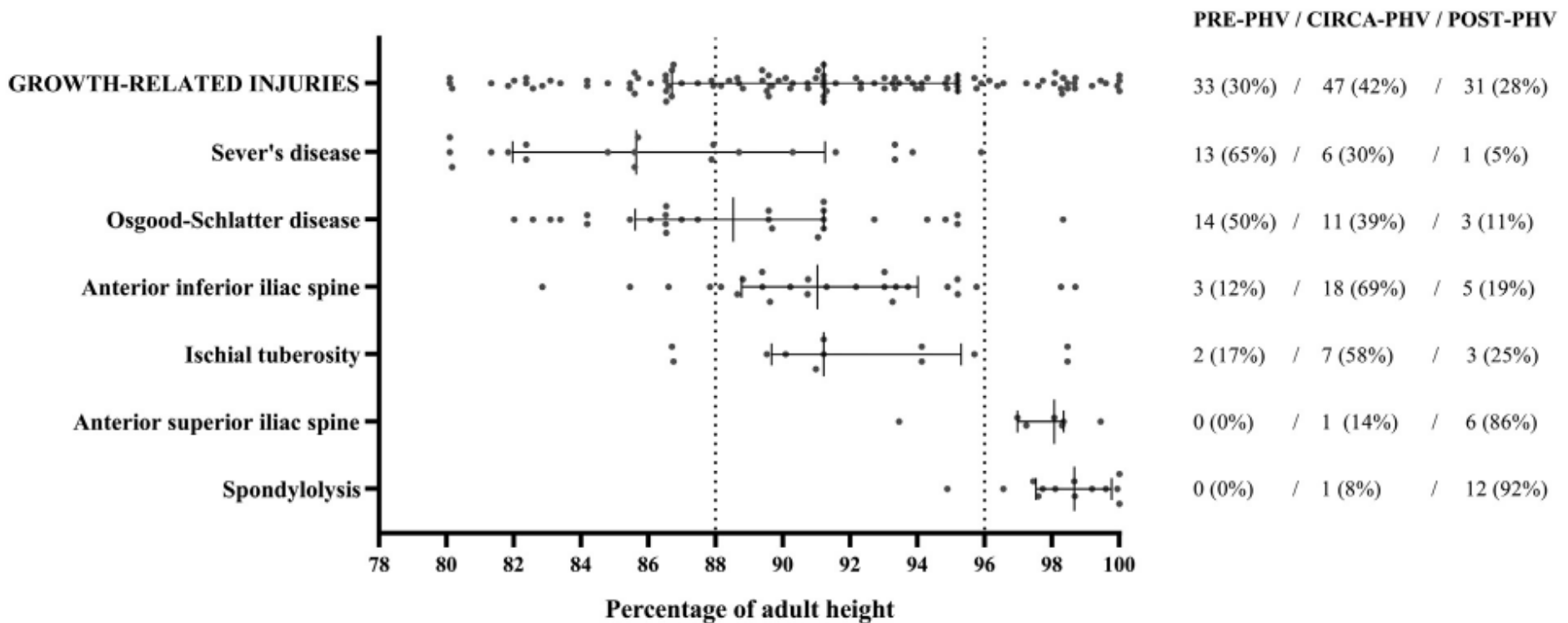


# MADURACIÓN



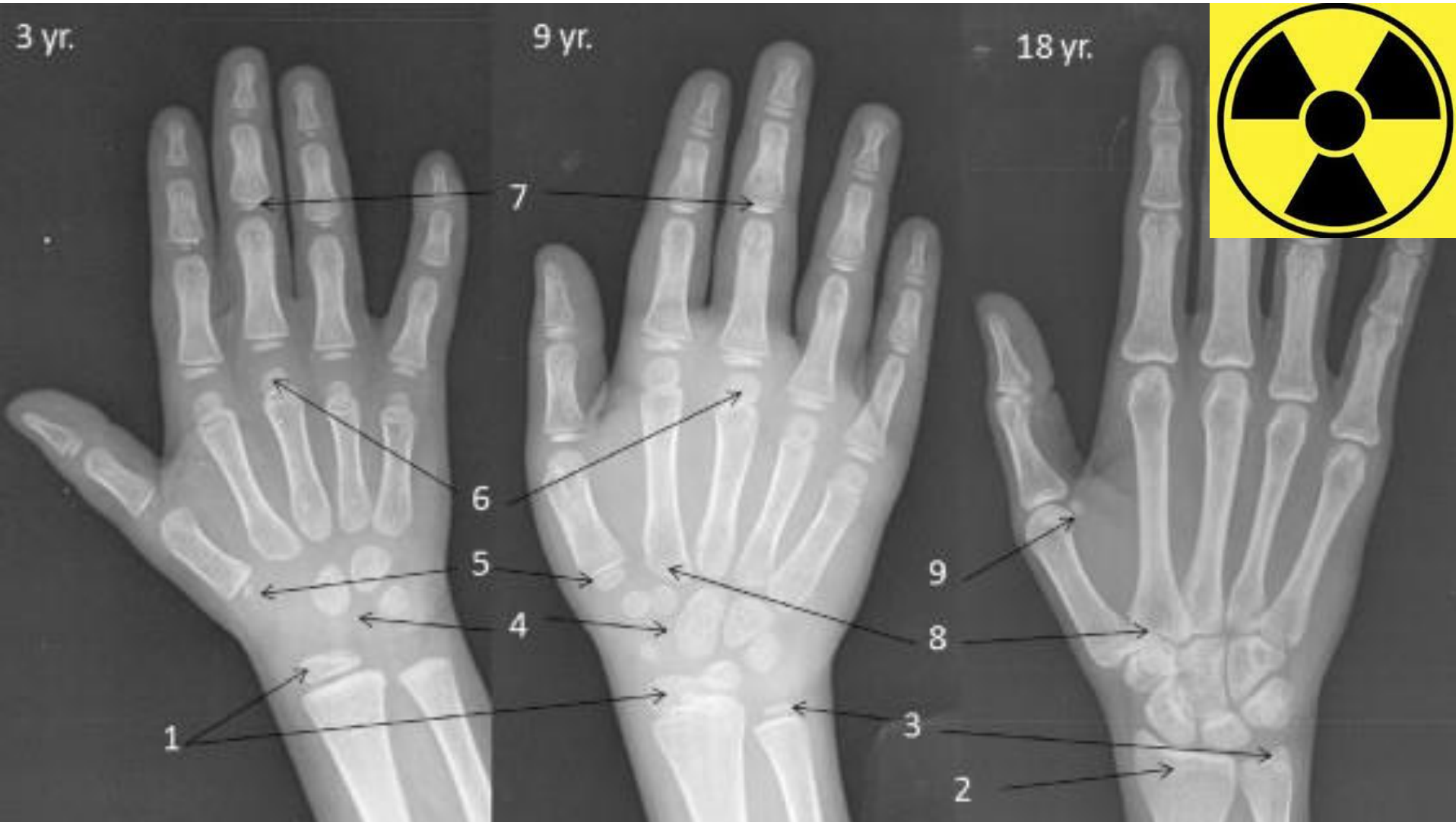


# MADURACIÓN





# + MADURACIÓN



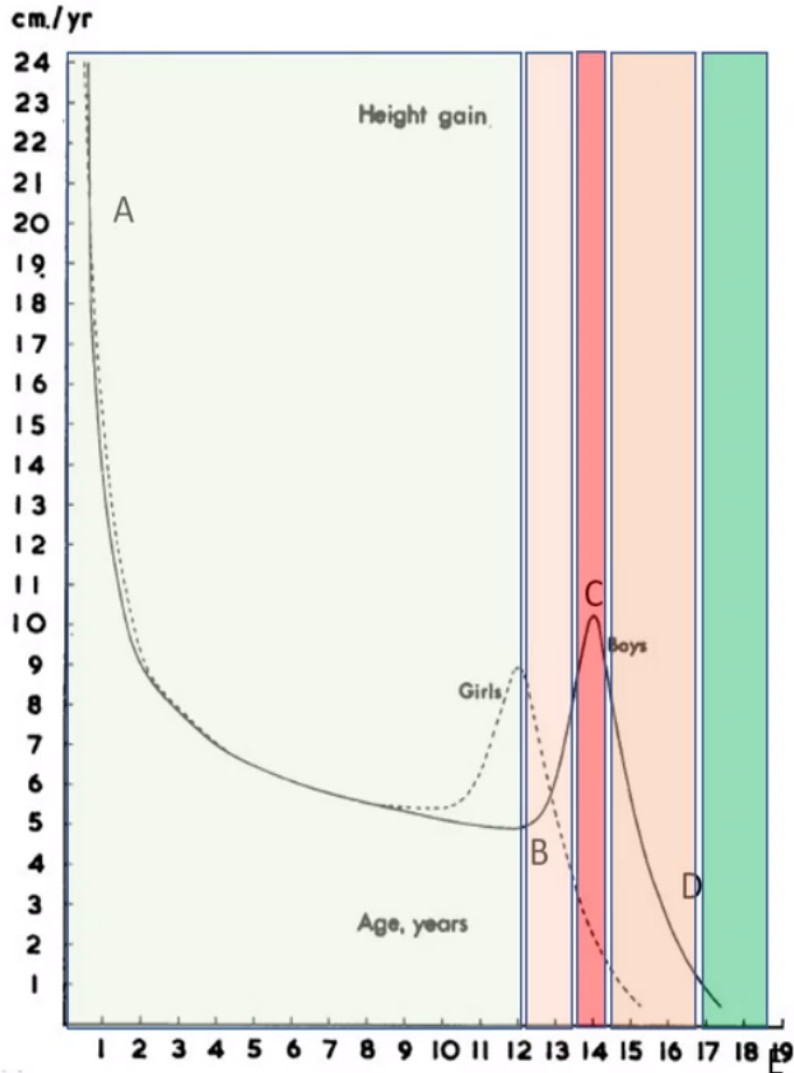
# + MADURACIÓN



Maduración sexual



# MADURACIÓN



A – Growth deceleration phase

B – Growth acceleration phase ~ onset of peak height velocity (PHV)

C – Peak height velocity (PHV)

D – Growth deceleration phase ~ cessation of PHV

E – Termination of growth

## Maduración somática



Adaptado de Towlson et al. (2020)



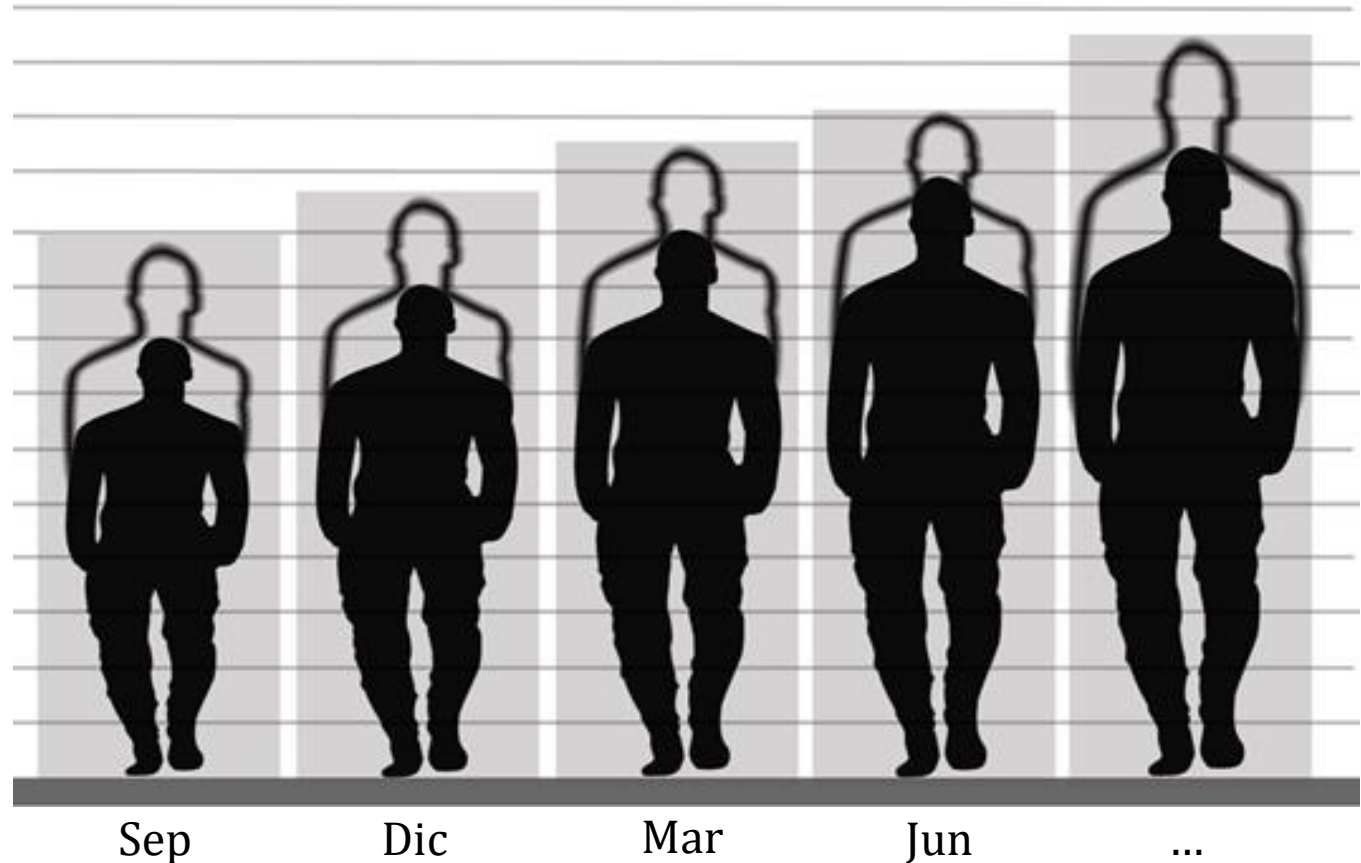
# MADURACIÓN

## Tempo

Se recomienda medir  
cada 3-4 meses



ATENCIÓN a  
incrementos  
>7.2cm/año o  
0.6cm/mes



# + MADURACIÓN

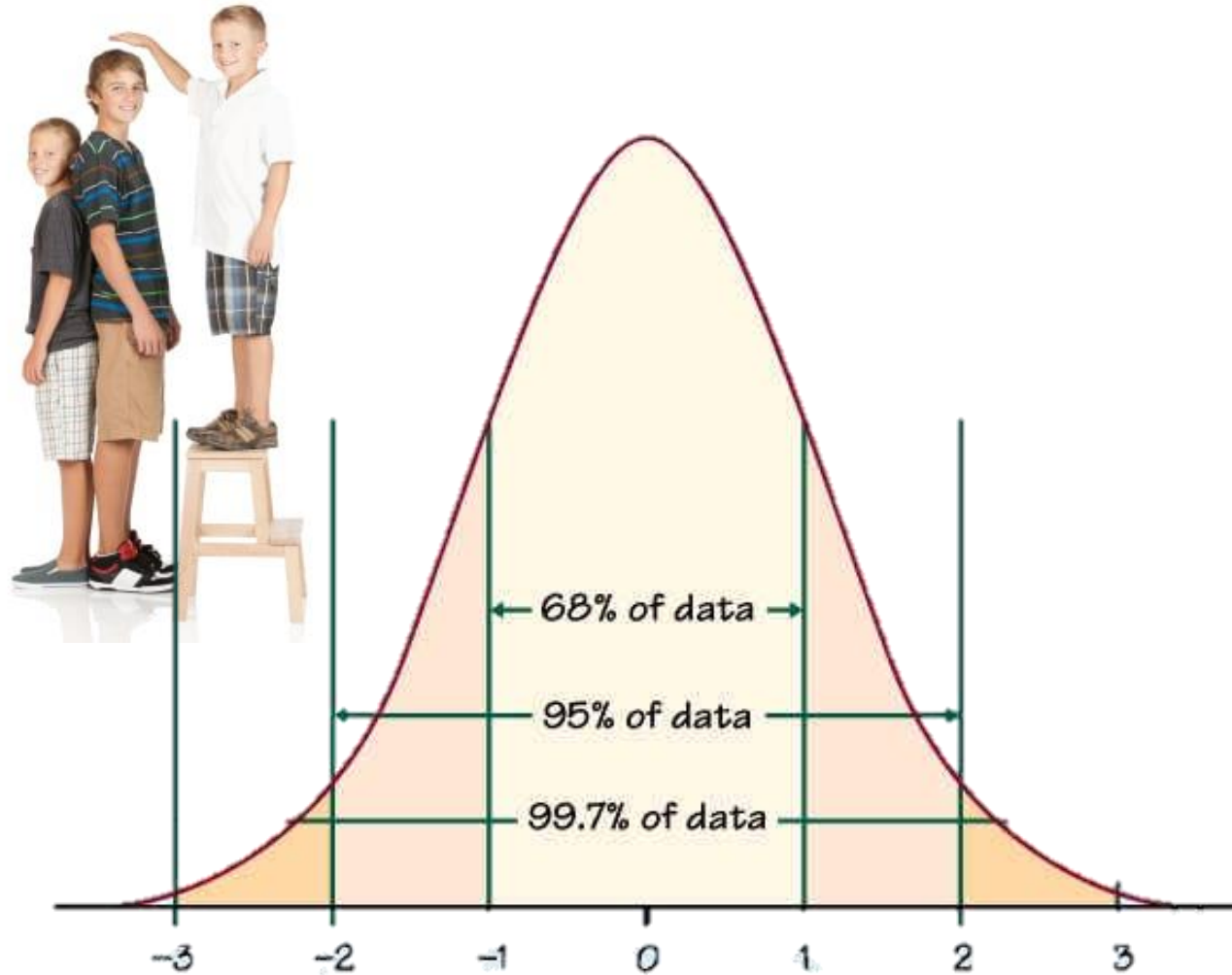
## Timing

### Z-Score

$< -0.5$  "Late maturing"

$-0.5$  to  $0.5$  "On time"

$> 0.5$  "Early maturing"





# MADURACIÓN

## Status

### Maturity offset

< -1 “Pre-puberal”

-1 to 1 “Puberal”

> 1 “Post-puberal”

### Prediction Adult Height

< 85% “Pre-puberal”

85 to 96% “Puberal”

> 96% “Post-puberal”

Name	Age	Stature (cm)	Body Mass (kg)	Sitting Height (cm)	Mother Height (cm)	Father Height (cm)	PAH (cm)	% PAH (Khamis-Roche)	Maturity Z-score	Modified Mirwald Maturity Offset
Fran	15.6	157.0	50.0	85.0	160	178	166.1	94.5	-0.5	0.8
	#N/A						#N/A	#N/A	#N/A	#N/A
	#N/A						#N/A	#N/A	#N/A	#N/A



**Mirwald et al. (2002). An assessment of maturity from anthropometric measurements. *Medicine and science in sports and exercise*, 34(4), 689-694.**

**Khamis & Roche (1994). Predicting adult stature without using skeletal age: the Khamis-Roche method. *Pediatrics*, 94(4), 504-507.**

Fransen et al. (2018). Improving the prediction of maturity from anthropometric variables using a maturity ratio. *Pediatric exercise science*, 30(2), 296-307.

Moore et al. (2015). Enhancing a somatic maturity prediction model. *Medicine & Science in Sports & Exercise*, 47(8), 1755-1764.



# ESPECIALIZACIÓN TEMPRANA

TABLE 5

Injuries Sustained During Participation in the NBA for Multisport and Single-Sport Athletes

Injury Type	Multisport, n	Single Sport, n
Anterior cruciate ligament	3	8
Lateral collateral ligament	0	1
Medial collateral ligament	1	6
Posterior cruciate ligament	0	2
Meniscus	1	14
Fracture	1	25
Hamstring	0	2
Tendon	0	9
Muscle	0	2
Tissue scarring	0	1
Sprain	1	6
Ankle or knee injury (unspecified, but required surgery)	0	14
Back + bulging/herniated disc	1	7
Hernia	0	4
Soreness	0	1
Hip	1	4
Dislocation	0	2
Bone bruise	0	1
Shoulder (unspecified)	0	7
Nerve	1	0
<b>Total</b>	<b>10</b>	<b>116</b>

## Association of Specialization and Training Volume With Injury History in Youth Athletes

2011 youth athletes (12-18 years) completed a questionnaire regarding their specialization status, yearly & weekly sport participation volume, injury history

### Result 1

Highly specialized athletes were more likely to report a previous injury of any kind (+59%) or an overuse injury (+45%) in the previous year



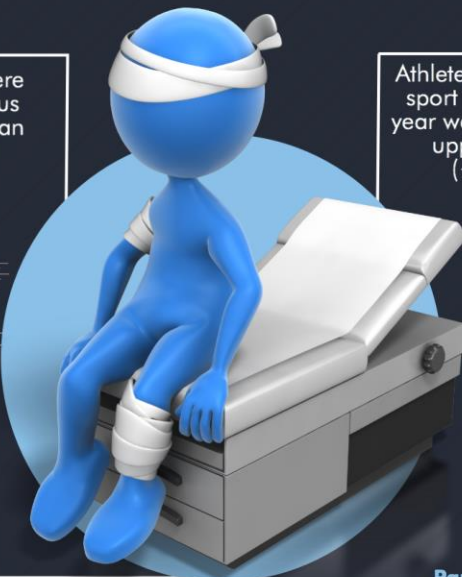
### Result 2

Athletes who played their primary sport more than 8 months of the year were more likely to report an upper extremity overuse injury (+68%) or a lower extremity overuse injury (+66%)



### Result 3

Athletes who participated in their primary sport for more hours per week than their age were more likely to report an injury of any type (+34%) in the previous year



Parents and youth athletes should be aware of the risks of specialization and excessive sport volume to maximize safe sport participation

Reference by E.G. Post et al. AJSM 2017

Designed by @YLMsportScience



# + VARIABLES PSICOLÓGICAS

FACTORES DE RIESGO DE LESIÓN

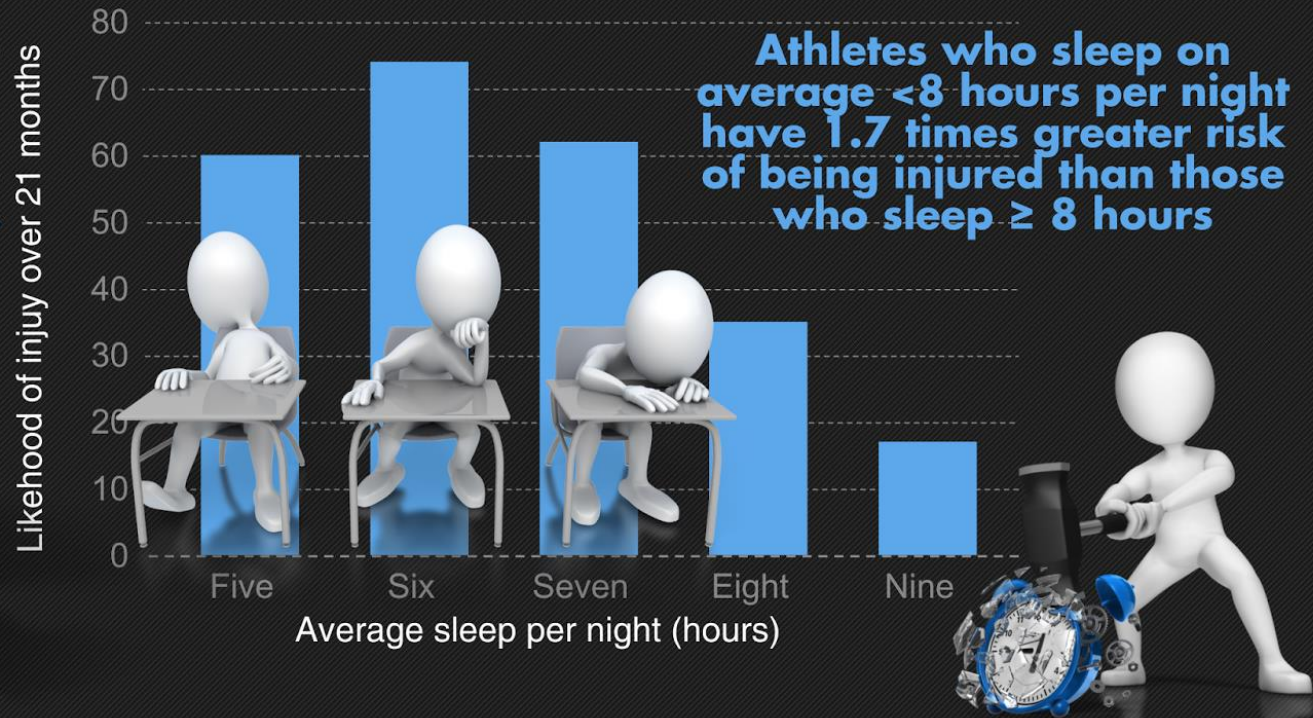




# SUEÑO

## Likelihood of Injury Based on Hours of Sleep per Night

Designed by  
©YLM Sport Science



### Reference

Chronic Lack of Sleep is Associated With Increased Sports Injuries in Adolescent Athletes  
by Milewski et al. in J Pediatr Orthop 2014



# SUEÑO

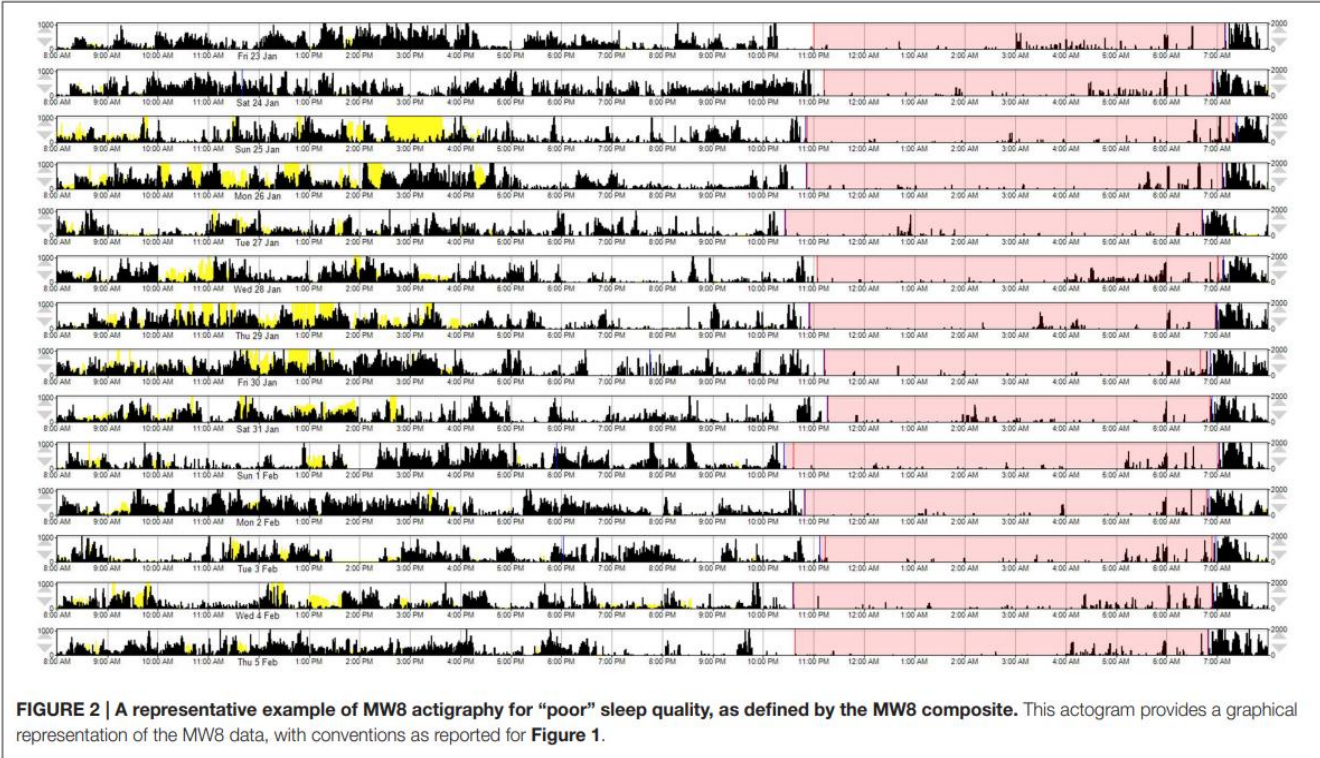


FIGURE 2 | A representative example of MW8 actigraphy for “poor” sleep quality, as defined by the MW8 composite. This actogram provides a graphical representation of the MW8 data, with conventions as reported for Figure 1.



## CUESTIONARIOS AUTORREPORTE

KAROLINSKA SLEEP DIARY (KSD)					
Indica como suele ser tu sueño la noche antes del parto.					
1. Calidad de sueño	1	2	3	4	5
	Muy pobre	Bastante pobre	No bueno ni malo	Bastante bueno	Muy bueno
2. Tranquilidad del sueño	1	2	3	4	5
	Muy inquieto	Bastante inquieto	Ni inquieto ni tranquilo	Bastante tranquilo	Muy tranquilo
3. Facilidad para dormirse	1	2	3	4	5
	Muy difícil	Bastante difícil	Ni difícil ni fácil	Bastante fácil	Muy fácil
4. Despertar	1	3	5		
	Despierto demasiado temprano	Despierto un poco temprano	No despierto temprano		
5. Facilidad para despertar	1	2	3	4	5
	Muy difícil	Bastante difícil	Ni difícil ni fácil	Bastante fácil	Muy fácil
6. Sensación de descanso	1	3	5		
	No descanso en absoluto	Algo descansado	Completamente descansado		
7. ¿Duermes lo suficiente?	1	2	3	4	5
	No, definitivamente muy poco	No, muy poco	No, muy poco, algo	Si, casi lo suficiente	Si, definitivamente lo suficiente



# ANSIEDAD

	Anxiety Symptoms						ARR (95% CI)
	Yes			No			
	Injuries, n	AEs	Rate per 10,000 AEs	Injuries, n	AEs	Rate per 10,000 AEs	
<b>Men</b>							
Overall	220	54,286	40.5	175	113,854	15.4	2.5 (2.1-3.0)
Game	67	6795	98.6	50	19,147	26.1	3.3 (2.2-4.8)
Practice	153	47,491	32.2	125	94,707	13.2	2.4 (1.9-2.9)
<b>Women</b>							
Overall	95	26,662	35.6	102	55,868	18.3	1.9 (1.5-2.4)
Game	26	4813	54.0	32	12,256	26.1	2.0 (1.2-3.5)
Practice	69	21,849	31.6	70	43,612	16.1	2.0 (1.5-2.6)

## CUESTIONARIO AUTORREPORTE

A-R

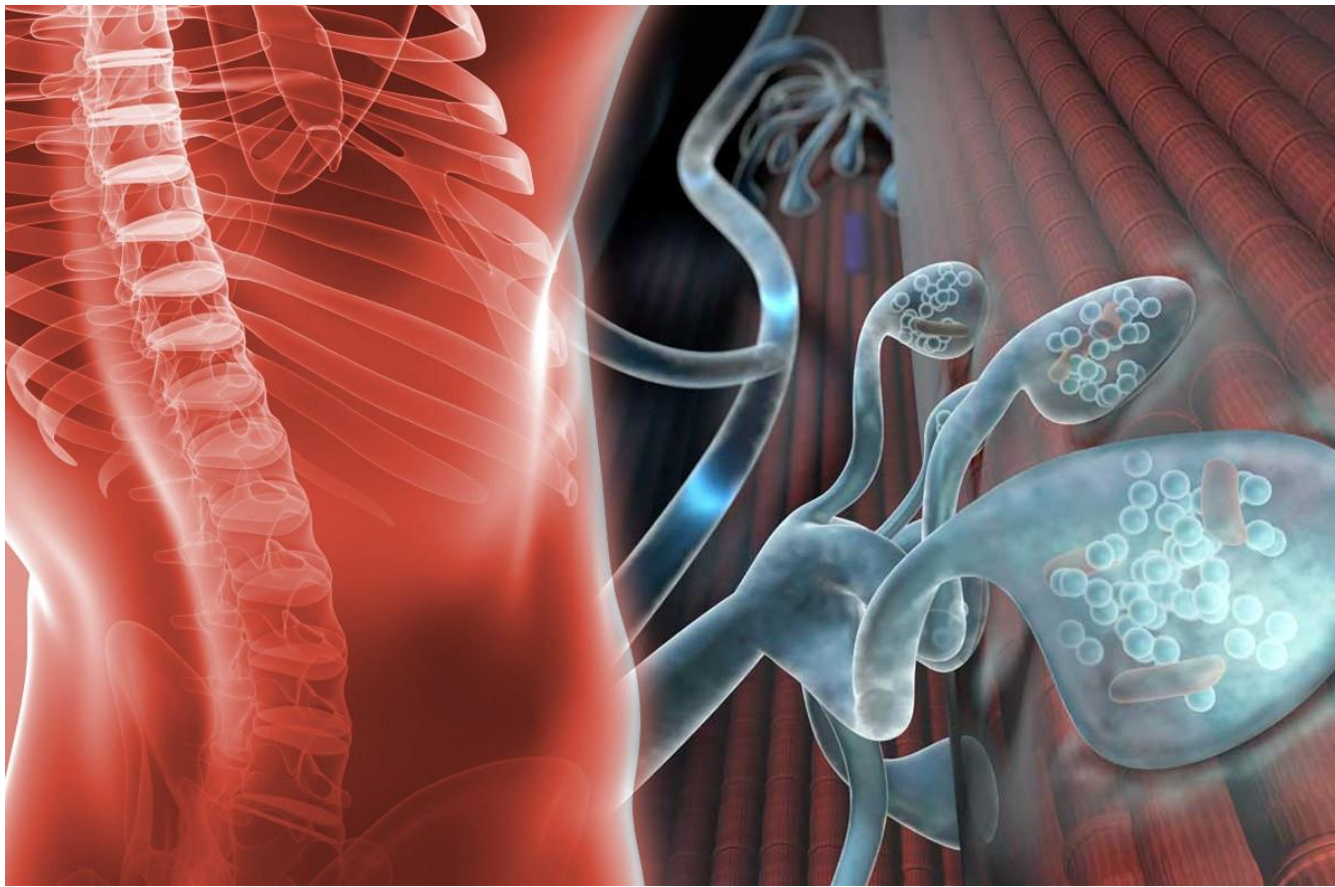
**INSTRUCCIONES**

Lea cada frase y señale la puntuación 0 a 3 que indique mejor cómo se *SIENTE* Vd. *EN GENERAL* en la mayoría de las ocasiones. No hay respuestas buenas ni malas. No emplee demasiado tiempo en cada frase y conteste señalando lo que mejor describa cómo se siente Vd. generalmente.

	0	1	2	3
21. Me siento bien .....	0	1	2	3
22. Me canso rápidamente .....	0	1	2	3
23. Siento ganas de llorar .....	0	1	2	3
24. Me gustaría ser tan feliz como otros .....	0	1	2	3
25. Pierdo oportunidades por no decidirme pronto .....	0	1	2	3
26. Me siento descansado .....	0	1	2	3
27. Soy una persona tranquila, serena y sosegada .....	0	1	2	3
28. Veo que las dificultades se amontonan y no puedo con ellas .....	0	1	2	3
29. Me preocupo demasiado por cosas sin importancia .....	0	1	2	3
30. Soy feliz .....	0	1	2	3
31. Suelo tomar las cosas demasiado seriamente .....	0	1	2	3
32. Me falta confianza en mí mismo .....	0	1	2	3
33. Me siento seguro .....	0	1	2	3
34. Evito enfrentarme a las crisis o dificultades .....	0	1	2	3
35. Me siento triste (melancólico) .....	0	1	2	3
36. Estoy satisfecho .....	0	1	2	3
37. Me rondan y molestan pensamientos sin importancia .....	0	1	2	3
38. Me afectan tanto los desengaños, que no puedo olvidarlos .....	0	1	2	3
39. Soy una persona estable .....	0	1	2	3
40. Cuando pienso sobre asuntos y preocupaciones actuales, me pongo tenso y agitado.	0	1	2	3

## STAI

Athletes who reported preseason anxiety symptoms had a significantly higher injury incidence rate in the prospective season compared with those who reported no preseason anxiety symptoms.



# + VARIABLES NEUROMUSCULARES

FACTORES DE RIESGO DE LESIÓN



# FUERZA EXTREMIDAD INFERIOR

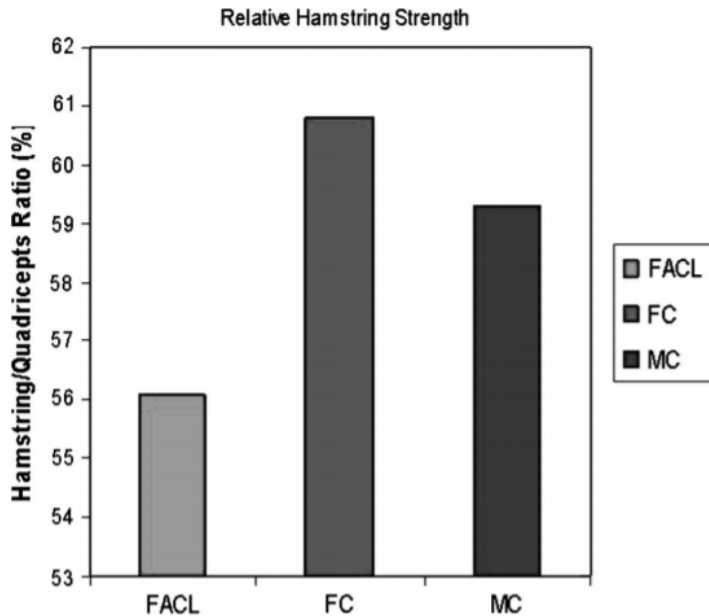


FIGURE 3. Median hamstrings to quadriceps ratio for each of the matched comparison groups. FACL, female ACL injured; FC, female control; MC, male control.

Myer et al. (2009)



↓ fuerza excéntrica isquios (<45° flexión rodilla)

↑ fuerza concéntrica cuádriceps (>60° flexión rodilla)

Ayala et al. (2016)

The findings of the current study also highlight that poor reciprocal hamstring-to-quadriceps ratios, calculated using angle specific torque values close to full extension, are present in the identification of players at high risk of HSI.

Ayala et al. (2019)



# FUERZA EXTREMIDAD INFERIOR

**FIELD-BASED HAMSTRING STRENGTH TESTS → Single leg hamstring bridge (SLHB)**



**As many repetitions as possible**

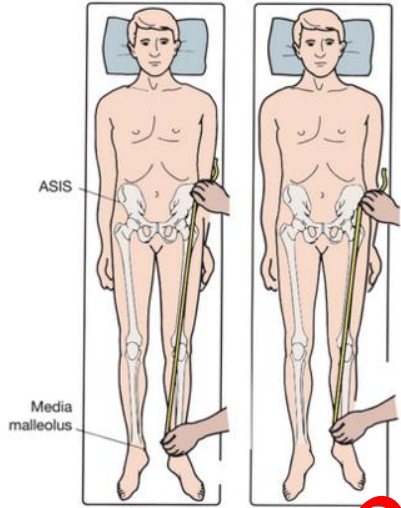
This assessment could also be considered a test of muscular endurance as opposed to strength, and places a greater emphasis on the concentric function of the hamstrings.

SLHB scores  $\leq 20$  reps increases risk of hamstring strain.

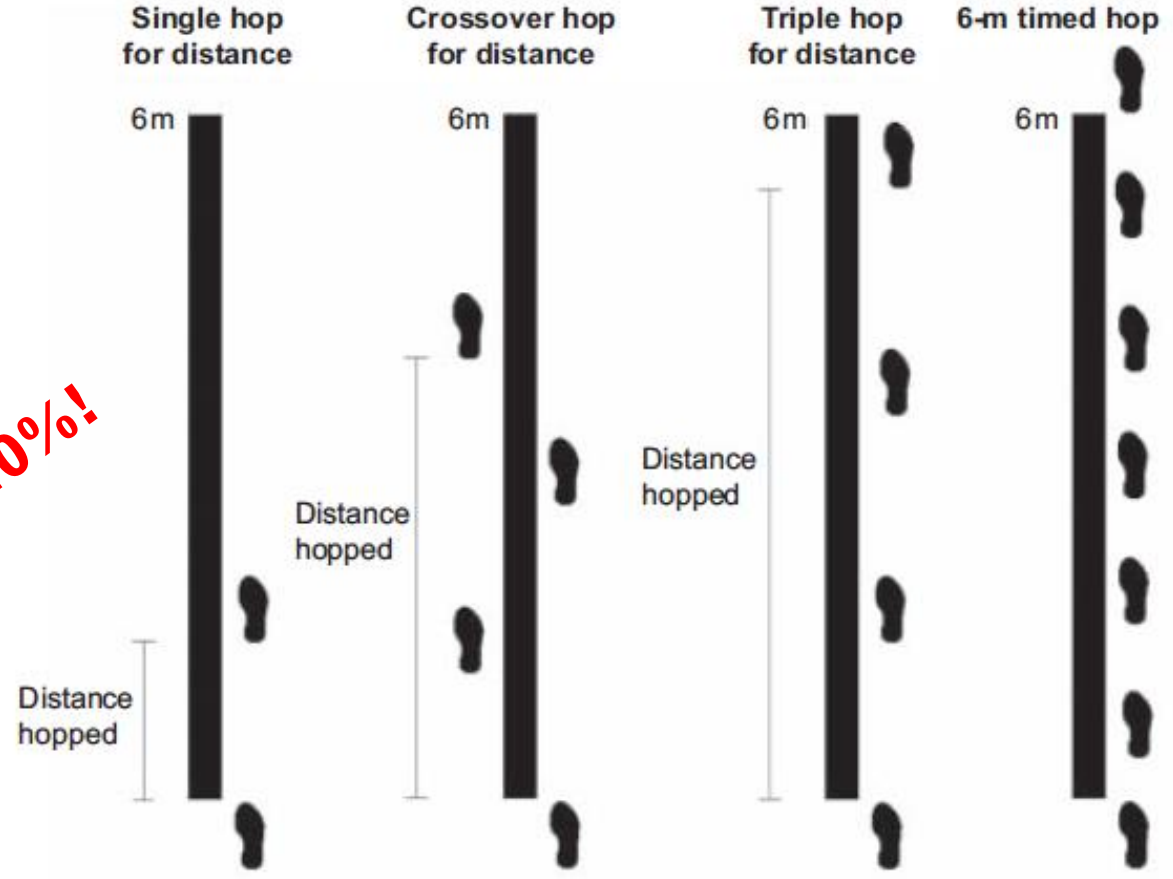
Freckleton et al. (2011 y 2013)



# FUERZA EXTREMIDAD INFERIOR

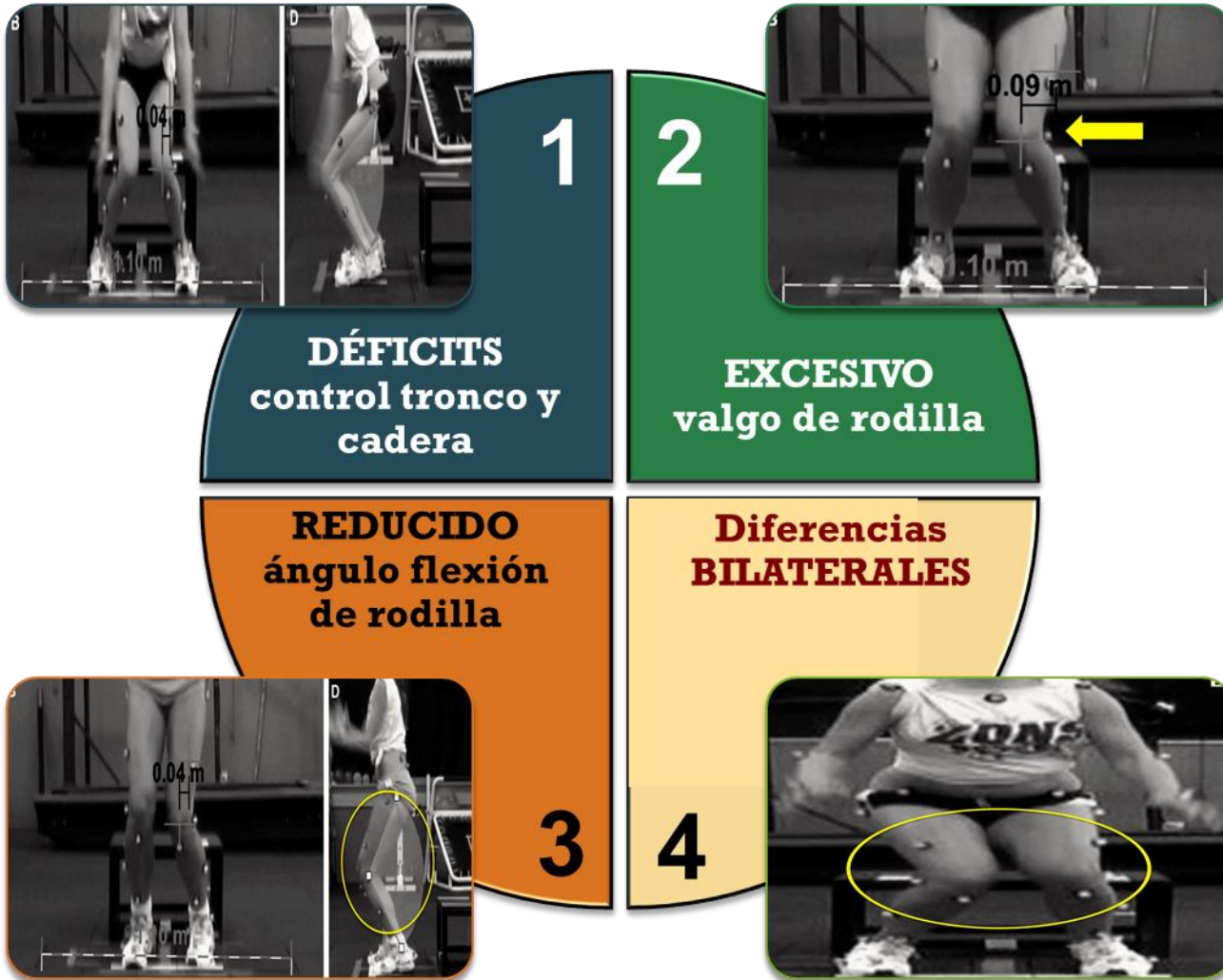


**¡CUIDADO CON  
DIFERENCIAS  
BILATERALES >10%!**





# PATRONES DE MOVIMIENTO







# PATRONES DE MOVIMIENTO

Tuck Jump Assessment	Pre	Mid	Post	Comments	
<b><u>Knee and Thigh Motion</u></b>					
① Lower extremity valgus at landing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>¡MÁS DE 6 = PROBLEMAS GRAVES!</b>	
② Thighs do not reach parallel (peak of jump)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
③ Thighs not equal side-to-side (during flight)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<b><u>Foot Position During Landing</u></b>					
④ Foot placement not shoulder width apart	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
⑤ Foot placement not parallel (front to back)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
⑥ Foot contact timing not equal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
7. Excessive landing contact noise	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<b><u>Plyometric Technique</u></b>					
8. Pause between jumps	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
9. Technique declines prior to 10 seconds	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
10. Does not land in same footprint (excessive in-flight motion)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Total _____	Total _____	Total _____			

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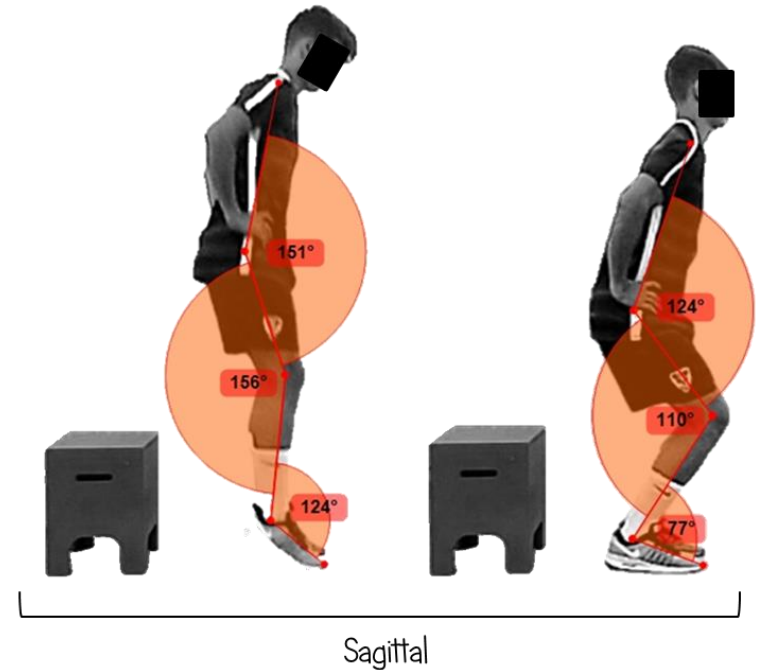
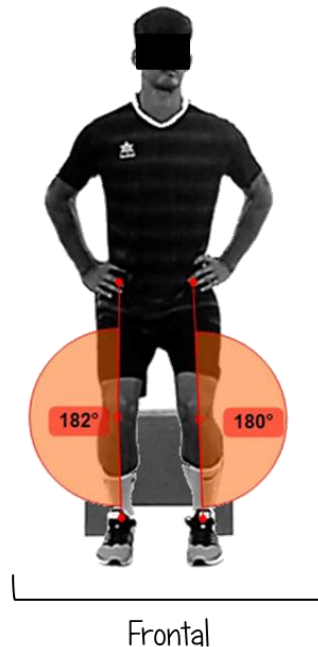
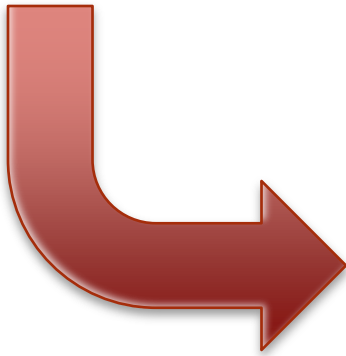
Figure 2 Tuck Jump Assessment: Six common mistakes that clinicians should aim to correct for their athletes while they perform the tuck jump exercise: (1) athletes display unwanted medial knee collapse, (2) athletes do not achieve the desired knees parallel position at top of flight, (3) athletes do not displayed synchronized lower limb positions during flight, (4) athletes land with their feet too close together, (5) athletes land in undesirable staggered position, and (6) athletes do not land with both feet at the same time.



# PATRONES DE MOVIMIENTO

## Highlights

- Subjective assessment of DVJ and tuck jump in youth athletes was rater dependent.
- Poor subjective knee control associated with smaller knee separation distance in DVJ.
- Subjective assessment of knee control should be used in tandem with 2D analysis.

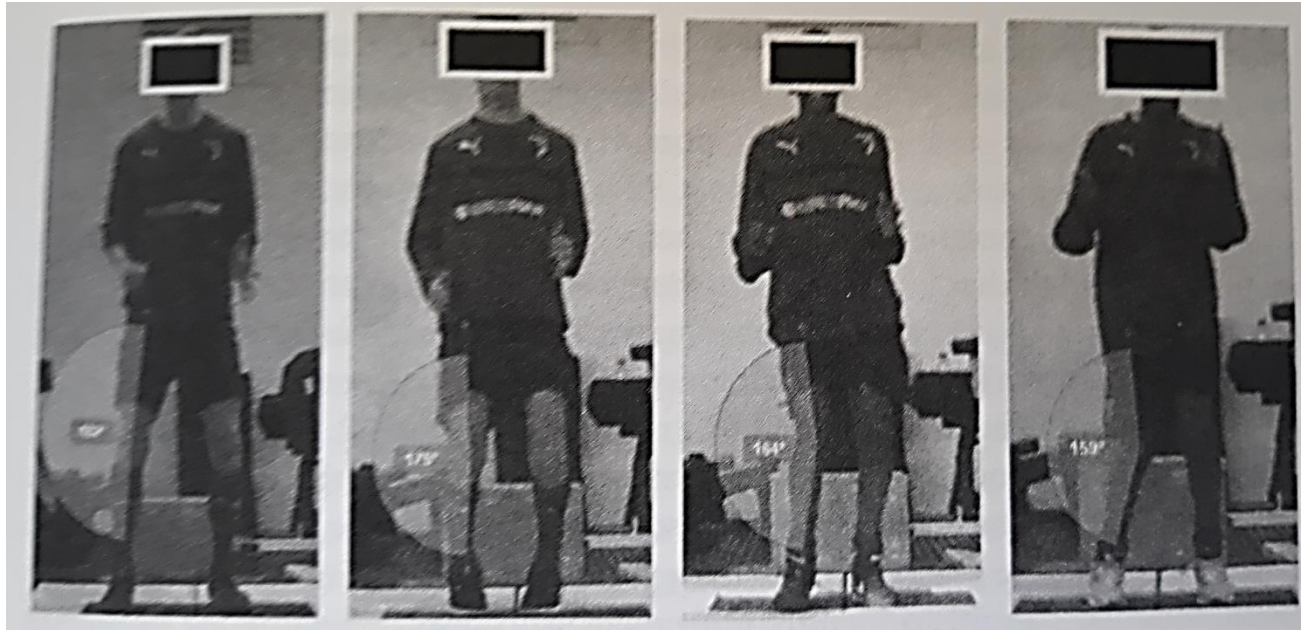


Lindblom et al. (2021)

Robles-Palazón et al. (2021)



# PATRONES DE MOVIMIENTO



0

0°

No valgo

1

1-9°

Menor

2

10-19°

Moderado

3

20-30°

Severo



# ESTABILIDAD DINÁMICA

TABLE 6. Adjusted odds ratios for potential lower extremity injury risk factors among high school basketball players.

Risk Factor	Category	LE Injury AOR <sup>‡</sup> (95% CI)
All players		
Normalized composite right reach distance*	≤94.0%	3.0 (1.5, 6.1)
Anterior reach distance difference <sup>†</sup>	≥4 cm	2.7 (1.4, 5.3)
Girls		
Normalized composite right reach distance*	≤94.0%	6.5 (2.4, 17.5)
Boys		
Anterior reach distance difference <sup>†</sup>	≥4 cm	3.0 (1.1, 7.7)

\* Reach distance is reach distance divided by limb length multiplied by 100. Right reach done by standing on left limb and reaching with the right limb.

<sup>†</sup>Difference between right and left anterior reach distances.

<sup>‡</sup> Adjusted odds ratio for gender, grade, previous injury, participation in a neuromuscular training program since initial measurement, and lower extremity tape/brace use.



**Baloncesto**

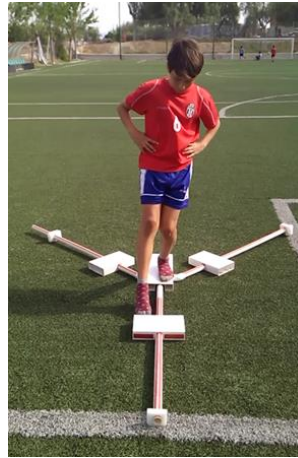
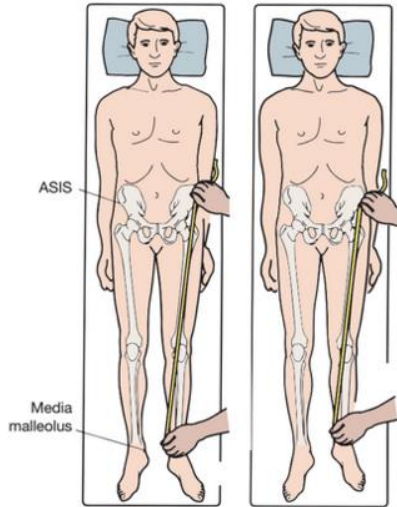
TABLE 2. Association between CS and asymmetry and injury in collegiate athletes during competitive season.

YBT Variable	OR	95% CI	P value
ANT asymmetry (>4-cm reference)	2.20	1.09–4.46	0.03
PM asymmetry (>4-cm reference)	1.15	0.58–2.30	0.69
PL asymmetry (>4-cm reference)	0.57	0.28–1.14	0.11
CS	1.00	0.95–1.04	0.69

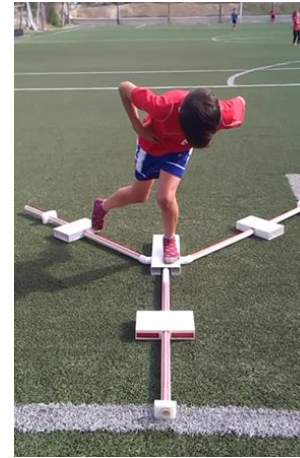
Anterior **asymmetry >4 cm** was significantly associated with noncontact injury.



# ESTABILIDAD DINÁMICA



Anterior



Posteromedial



Posterolateral

To express **reach distance** as a **percentage of limb length**, the **normalized value** was calculated as reach distance divided by limb length then multiplied by 100.

$$[\text{Distancia alcanzada} / \text{longitud pierna}] \times 100$$

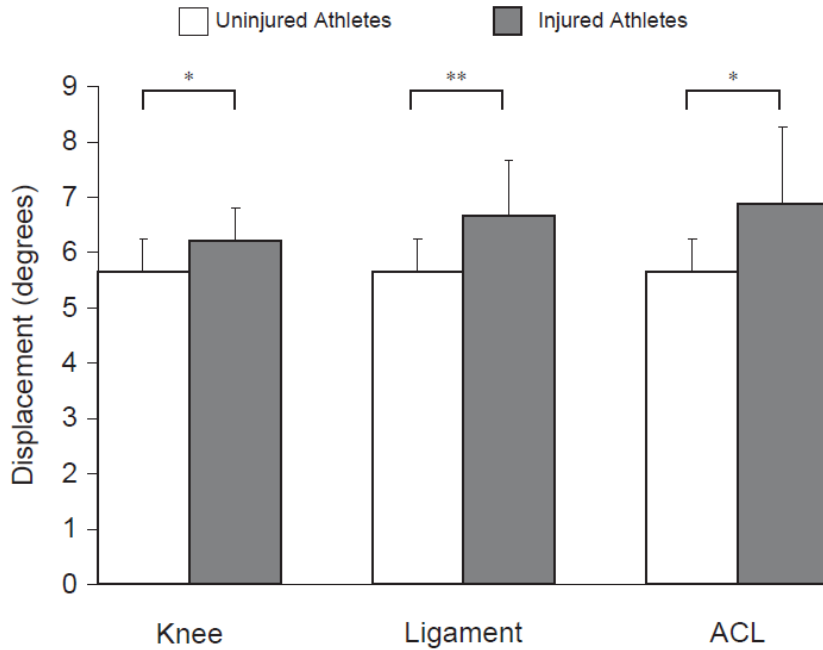
**Composite reach distance** was the sum of the 3 reach directions divided by 3 times limb length, then multiplied by 100

$$[(\text{Anterior} + \text{Postero-Medial} + \text{Postero-Lateral}) / (3 \times \text{longitud pierna})] \times 100$$



# ESTABILIDAD DINÁMICA

SCORE



Rotary stability



Trunk stability push-up

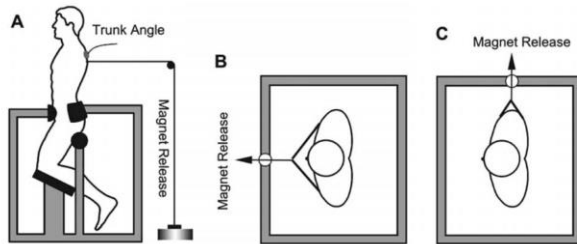


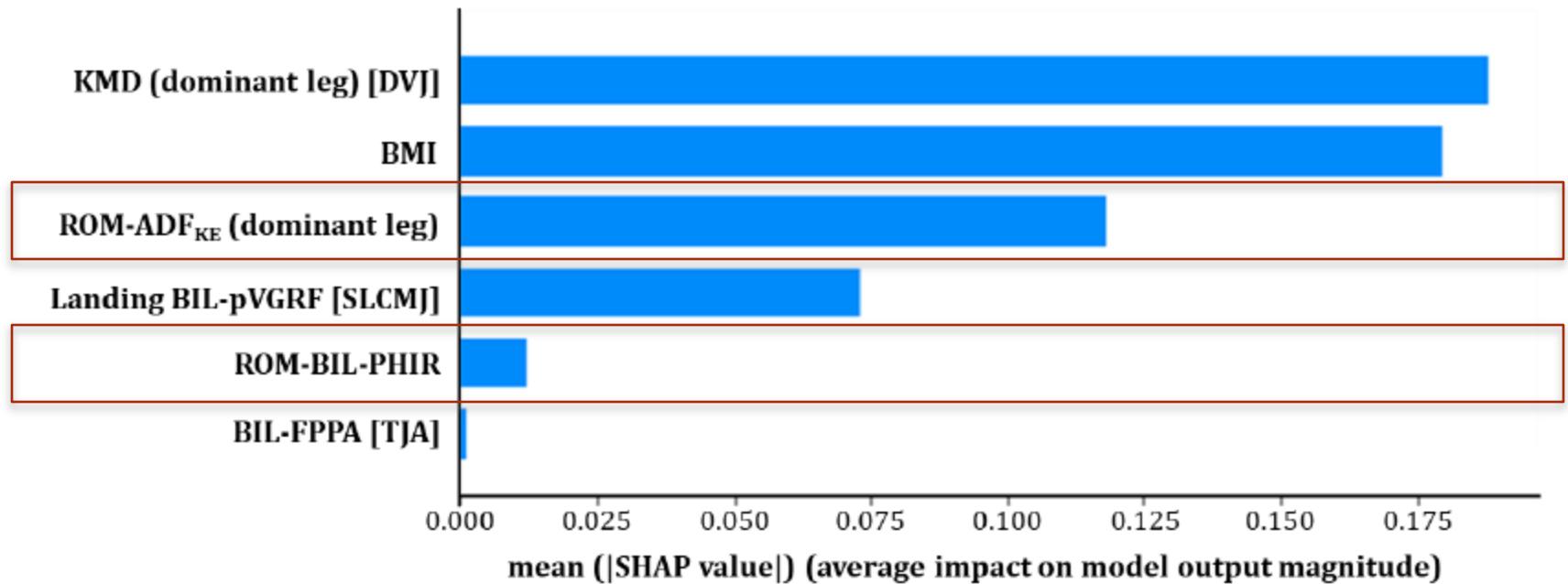
Figure 1. A subject positioned in a multidirectional, sudden force release apparatus. Flexion (A), extension (B), and lateral bending (C) loads were applied via a system of pulleys.

Zazulak et al. (2007)

Cook et al. (2006a, 2006b)



# RANGO DE MOVIMIENTO



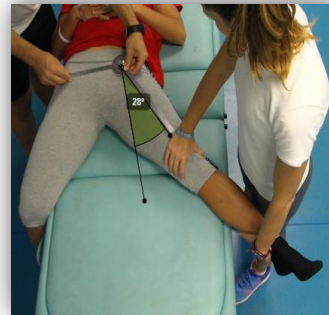
Robles-Palazón et al. (2021)

Hip flexion with knee extended, hip abduction, ankle dorsiflexion with knee flexed, and ankle dorsiflexion with extended ROM measures.

Ruiz-Pérez et al. (2021)



# RANGO DE MOVIMIENTO



ROM-SPORT

Cejudo et al. (2020)