Risk factors associated with Medial Tibial Stress Syndrome in military cadets during basic training

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ABSTRACT

Medial Tibial Stress Syndrome (MTSS) is one of the most frequent pathologies in military personnel. As the muscles of the lower extremity contribute to the attenuation of impact forces in activities such as running and jumping, neuromuscular performance deficiencies and asymmetries may be associated with an increased risk for musculoskeletal injuries. PURPOSE: to determine the kinetic risk factors associated with MTSS through the bilateral countermovement jump (CMJ) in army cadets. METHODS: ethical approval was granted by the General José María Córdova Military School of Cadets where the study was conducted. This observational study was executed in a cohort of 123 cadets (followed for 24 weeks) who entered to the military school in 2017. Anthropometric, demographic data and MTSS history were recorded. Jump height (cm), peak landing force (N*kg), peak landing force asymmetry (%), concentric mean force (N*kg), concentric mean force asymmetry (%), eccentric deceleration rate of force development (EDRFD [N/s*Kg]) and EDRFD asymmetry (%) were evaluated through the bilateral CMJ on a pair of uniaxial force platforms. After the follow-up, the cadets with MTSS were determined through the clinical history.

RESULTS: the incidence of MTSS was 13% (n= 16). Greater EDRFD asymmetry (9,4% vs. -3,4%), female sex (RR= 2.84; 95% CI= 1.16-6.94), rural provenance (RR= 2.65; 95% CI= 1.04-6.72), and previous history of MTSSM (RR= 5.71; 95% CI= 2.23-14.62), were significantly associated with MTSS (p≤0.05). In the logistic regression, greater EDRFD asymmetry (OR= 1.03; 95% CI= 1.00-1.07), female sex (OR= 4.91; 95% CI = 1.38-13.37) and rural provenance (OR= 4.82; 95% CI= 1.04-6.72), were significantly associated with MTSS (p ≤0.05). Previous history of MTSS was significant in p≤0.1 (OR= 8.95; 95% CI= 0.68-118.73). The predictive model was significant for the MTSS (p≤0.01), had a sensitivity of 31.3% and a specificity of 99.1% (overall prognosis of 90.2%). CONCLUSIONS: while we identified important non-modifiable risk factors for MTSS in cadets during basic training, we also found that greater EDRFD asymmetry was a significant risk factor. This suggests that the bilateral CMJ may be a useful tool for pre-entry screening and that high EDRFD asymmetry could be a potential target of pre-basic training risk reduction conditioning.

INTRODUCTION

- Medial Tibial Stress Syndrome (MTSS) is one of the most reported and disabling pathologies in military personnel (1, 2).
- The incidence reported in military personnel for this pathology ranges between 7.2% and 35% (2).
- MTSS is characterized by a diffuse pain in the middle third of the posteromedial edge of the tibia (1, 3). Involves cortical bone microfractures (3).
- The association between the kinetic variables implicit in the jump and the MTSS (in athletes, civilian or military population) has not been examined, although some of these have been associated with several musculoskeletal injuries (MSI) (4).
- The countermovement jump (CMJ) is a widely used tool for the monitoring of neuromuscular status in military personnel (5).
- Due to the muscles of the lower limb play an important role in attenuating the impact forces in activities such as running and landing (6), neuromuscular performance deficiencies and asymmetries are associated with an increased risk for MSI (4, 7).

MEASUREMENTS

Demographic data: age, sex and provenance of the participants.

Physical activity habits, smoking habits and consumption alcohol habits, through the Global Physical Activity Questionnaire (GPAQ) and the Global Adult Tobacco Survey (GATS).

Previous use of orthopedic material and, previous history of musculoskeletal injuries in the lower limbs and MTSS.

Basic anthropometric measures: height, weight and BMI (height meter SECA mBCA 515/514 and scale Tanita BC-1500 ANT+Wireless).

Kinetic variables: jump height (cm), eccentric deceleration rate of force development (EDRFD [N/s*Kg]), EDRFD asymmetry (% and %/NV), concentric mean force (N*kg), concentric mean force asymmetry (% and %/NV), peak landing force (N*kg) and peak landing force asymmetry (%), were evaluated by means of a pair of PASCO® uniaxial force platforms, through the bilateral CMJ. The data obtained were processed using the ForceDekcs® software.

MTSS: at the end of the follow-up time, the cadets with MTSS were identified through the electronic medical record found in the health information system of the colombian military forces.

PURPOSE

To determine the kinetic risk factors associated with MTSS through the bilateral countermovement jump (CMJ) in army cadets.

METHODS

- A cohort of 123 cadets (91 men and 32 women), who entered to the general José María Córdova Military School (ESMIC-Bogotá, Colombia) in 2017, was followed prospectively for 24 weeks.
- This cohort included subjects from all regions of the country.
- This research was approved by the Committee of Ethics in Social and Exact Sciences of ESMIC according to act 4363 REG-AL-FOL-71/02-2018.

STATISTIC ANALYSIS

Descriptive statistics (univariate analysis).

Categorical variables: chi-square and relative risk (RR).

Continuous variables: mean / median difference (T-Student / U-Mann Whitney).

Predictive model: binary logistic regression (multivariate analysis).

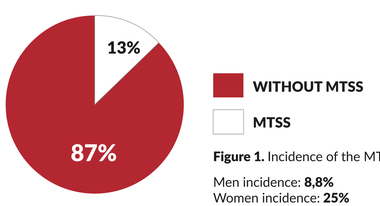

Figure 1. Incidence of the MTSS.

Men incidence: **8,8%**
Women incidence: **25%**

Table 1. Baseline characteristics of the sample

	Mean	SD
Age (years)	18,2	1,2
Weight (kg)	61,8	9,9
Height (m)	1,71	0,08
BMI (kg/m^2)	21,1	2,9

Table 2. Relative risk for MTSS according to demographic and lifestyle variables

	n	MTSS Incidence (%)	RR	95% CI	p-value†
Sex					0,019**
Men	91	8,8	REF	-	
Women	32	25	2,84	1,16-6,94	
Provenance					0,044**
Urban	105	10,5	REF	-	
Rural	18	27,8	2,65	1,04-6,72	
Current cigarette consumption					0,698
No	122	13,1	-	-	
Yes	1	0	-	-	
Previous cigarette consumption					0,768
No	113	13,3	1,32	0,19-9,03	
Yes	10	10	REF	-	
Previous alcohol consumption					0,861
No	9	11,1	REF	-	
Yes	114	13,2	1,18	0,17-7,97	
Consumption of alcohol in the last three months					0,77
Never	47	12,8	1,03	0,37-2,88	
1 or 2 times	57	12,3	REF	-	
Monthly	16	12,5	1,01	0,23-4,42	
Weekly	3	33,3	2,71	0,47-15,53	
Current practice of physical exercise or sport					0,593
No	11	18,2	1,45	0,37-5,58	
Yes	112	12,5	REF	-	
Weekly frequency of physical exercise or sport					0,122
≤2 days	26	7,7	1,3	0,19-8,67	
3-5 days	63	19	3,23	0,76-13,63	
≥6 days	34	5,9	REF	-	

** Significance of p≤0.05; *** Significance of p≤0.01; † Chi-square test.

Table 2. Relative risk for MTSS according to demographic and lifestyle variables (continuation...)

Daily time of physical exercise or sport					0,413
<1 hour	34	14,7	2,35	0,49-11,27	
1-2 hours	57	15,8	2,52	0,58-10,98	
> 2 hours	32	6,3	REF	-	
Previous use of orthopedic material					0,918
No	116	12,9	REF	-	
Yes	7	14,3	1,1	0,16-7,20	
Previous history of MTSS					0,005***
No	120	11,7	REF	-	
Yes	3	66,7	5,71	2,23-14,62	
Previous history of MSI in the lower extremity					0,593
No	112	12,5	REF	-	
Yes	11	18,2	1,45	0,37-5,58	

** Significance of p≤0.05; *** Significance of p≤0.01; † Chi-square test.

Table 3. Difference of the groups with and without MTSS for the kinetic variables of the CMJ

	MTSS (n= 16)		No MTSS (n= 107)		p-value†
	X (SD)	95% CI	X (SD)	95% CI	
Jump Height (cm)	26,1 (7,4)	22,2-30,1	28,6 (5,8)	27,5-29,7	0,129
EDRFD Asymmetry (%)	19,4 (14,5)	11,7-27,1	15,7 (11,0)	13,6-17,8	0,417
EDRFD Asymmetry (%/NV)	9,4 (22,8)	-2,8-[21,5]	-3,4 (18,9)	-7,0-[0,3]	0,016**
EDRFD (N/s*kg)	43,8 (11,1)	37,9-49,7	41,4 (15,2)	38,5-44,3	0,314
Concentric Mean Force Asymmetry (%)	5,8 (4,0)	3,7-7,9	7,3 (5,4)	6,2-8,3	0,434
Concentric Mean Force Asymmetry (%/NV)	1,1 (7,1)	-2,6-[4,9]	-2,3 (8,8)	-4,0-[-0,6]	0,138
Concentric Mean Force (N*kg)	9,7 (1,3)	9,0-10,4	9,3 (1,2)	9,1-9,6	0,636
Peak Landing Force Asymmetry (%)	12,1 (8,6)	7,5-16,7	18,4 (14,4)	15,7-21,2	0,139
Peak Landing Force Asymmetry (%/NV)	0,8 (15,1)	-7,2-[8,9]	3,6 (23,2)	-0,8-[8,1]	0,642
Peak Landing Force (N*kg)	29,3 (5,6)	26,3-32,3	29,9 (7,8)	28,4-31,4	0,774

** Significance of p≤0.05; † T-Student or U-Mann Whitney test.
EDRFD = rate force development in eccentric deceleration.

Cadets with a right asymmetry for the EDRFD had 2.06 (95% CI = 0.79-5.31, p = 0.125) more times risk of suffering MTSS than those with a left asymmetry.

Table 4. Difference of the groups with and without MTSS based on the dominance for the EDRFD asymmetry

	MTSS (n= 10)		No MTSS (n= 45)		p-value†
	X (SD)	95% CI	X (SD)	95% CI	
Right dominance for the EDRFD asymmetry (%)	23,0 (14,0)	13,0-33,0	14,7 (9,8)	11,7-17,6	0,029**
	MTSS (n= 10)		**No MTSS (n= 45)**		**p-value†**
	X (SD)	95% CI	X (SD)	95% CI	
Left dominance for the EDRFD asymmetry (%)	-13,4 (14,4)	-28,5-[1,8]	-16,5 (11,8)	-19,4-[-13,5]	0,552

** Significance of p≤0.05; † T-Student test.

Cadets with asymmetries ≥20% had 2.84 (0.91-8.86, p = 0.061) times more risk of suffering MTSS than those with asymmetries <20%.

Table 5. Risk factors associated with MTSS in the multivariate predictive model

	B (coefficient)	Standard error	Wald	p-value	OR (Exp[B])	95% IC
Sex	1,59	0,65	6,08	0,014**	4,91	1,38-13,37
Provenance	1,572	0,69	5,18	0,023**	4,82	1,24-18,66
Previous history of MTSS	2,192	1,32	2,76	0,097*	8,95	0,68-118,73
EDRFD Asymmetry (%/NV)	0,034	0,02	4,49	0,034**	1,03	1,00-1,07
Constant	-3,037	0,53	32,57	0	0,05	

* Significance of p≤0.1; ** Significance of p≤0.05.

The predictive model was significant for the MTSS (p≤0.01), had a sensitivity of 31.3% and a specificity of 99.1% (overall prognosis of 90.2%).

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CONCLUSIONS

Female sex, rural provenance, previous history of MTSS and a great asymmetry in the EDRFD are important risk factors for the development of the MTSS. These findings will allow to make a better prediction of the MTSS in military personnel, being especially useful for the classification of risk and the implementation of a primary prevention program aimed at cadets who begin their military training at the entrance of the ESMIC.