PREVALENCE OF MEDIAL TIBIAL STRESS SYNDROME AMONG INTERMEDIATE MALE FOOTBALL PLAYERS: AN OBSERVATIONAL STUDY

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Abstract : Background and Purpose: Medial tibial stress syndrome (MTSS), widely recognized as shin splints, is a common overuse injury tied to repetitive mechanical loading of the shin bone. Because football requires constant sprinting, jumping, landing, and sharp changes in direction, players put massive stress on their lower limbs. For this observational survey study, we looked at 130 intermediate male football players aged 18 to 22 years to see how common MTSS is, how it presents clinically, how it impacts training, and how it relates to training loads using the acute-to-chronic workload ratio (ACWR).
Results: MTSS was identified through the Shin Palpation Test and measured how severe it was using the MTSS Score. Out of the 130 players, 89 had MTSS, giving a prevalence rate of 68.46% (95% CI: 59.73–76.33). Among the affected players, the median MTSS score came out to 3 (IQR = 2), and 46.07% reported that their training was actually disrupted. Players dealing with MTSS also showed higher perceived exertion, greater fourth-week acute training loads, and elevated coupled and uncoupled ACWR values. We found notable links with age, how many years they had played football, practice session lengths, competitive level, dominant leg, shoe type, and playing surface.
Conclusion: Overall, the findings show a high burden of MTSS and the results highlight that MTSS is a major issue for intermediate male footballers pointing to the need for early checks, careful load management, and proper footwear. Since our study was cross-sectional, we cannot claim cause and effect.

IndexTerms **- Medial tibial stress syndrome, shin splints, football players, prevalence, acute:chronic workload ratio, training load.**

INTRODUCTION

Back in 1966, the American Medical Association defined medial tibial stress syndrome—commonly called 'shin splints'—as lower leg pain or discomfort caused by running repeatedly on hard surfaces or overworking the foot flexors, while making sure to rule out stress fractures or blood circulation issues. Basically, MTSS is a lower limb overuse injury marked by intense bone stress on the tibia along with periostitis. These injuries happen when repetitive microtrauma breaks down local tissue faster than the body can repair it, leading to cellular breakdown and localized tenderness[3].

Football (or soccer, depending on where you are) is a team sport where two squads try to score goals using mostly their feet, head, and torso. The game is built around core actions like sprinting, kicking, landing, cutting, heading, and passing. Doing these high-impact movements over and over places heavy stress on players' lower legs, which makes MTSS a very real concern. Men's football is a demanding contact sport filled with bursts of sprinting, jogging, walking, jumping, and sudden pivots. While the physical toll varies depending on whether someone plays recreationally, in amateur clubs, or at elite international levels, injury rates across the sport remain among the highest anywhere[6].

Looking at professional male players, muscle and tendon strains make up about 39.78% of injuries, followed by joint and ligament issues at 21.13%, bruises at 17.86%, and fractures at 3.27%. For amateur players, those numbers shift to 44.56% for muscles and tendons, 27.62% for joints and ligaments, 15.0% for bruises, and 3.05% for fractures. Amateurs actually experience more sudden, traumatic injuries (76.88%) compared to pros (64.16%), but the opposite happens with overuse injuries—pros see 27.62% while amateurs sit at 21.13%. Contact injuries happen most to pros (50.70%), whereas non-contact issues are more common among amateurs (54.04%). Most injuries in both groups are moderate, though severe injuries hit amateurs about 9.60% harder than pros. Reoccurrence rates are also slightly higher for amateurs (16.66%) than pros (15.25%), showing just how much these injuries affect players' health long-term[7].

MTSS itself shows up as exercise-induced pain along the front of the shin, with soreness when pressing along the inner edge of the shinbone for five centimeters or more. It is basically an early warning sign before a full stress fracture. Affecting around 35% of athletes, it pops up constantly in sports that involve running and jumping, as well as among military recruits[2].

Back in 1995, Fredericson created a five-point MRI grading system for MTSS, which later turned into a six-point scale known as the Fredericson classification. It goes from Grade 0 (completely normal), Grade 1 (periosteal swelling), Grade 2 (bone marrow swelling on T2 images), Grade 3 (swelling on both T1 and T2 images), up to Grade 4a (multiple focal intracortical signals) and Grade 4b (linear intracortical changes)[12].

PATHOPHYSIOLOGY

The root cause of MTSS comes down to microscopic damage piling up in the outer shell of the lower tibia faster than it can heal, acting essentially as a bone overload injury. You usually get inflammation of the outer bone lining (periostitis) right where the injury is happening. The pain itself is tied to this inflammation and tiny micro-cracks caused by the soleus or tibialis posterior

muscles pulling too hard over and over. When the mechanical stress beats the body's repair limits, MTSS develops. Training errors—like suddenly ramping up your volume on hard concrete—paired with worn-out shoes are major culprits here[1].

ETIOLOGY

Because MTSS is an overuse injury, its roots lie in repeated bone stress, irritated periosteum, and tibial bending, pulling in muscles like the soleus, tibialis anterior, and flexor digitorum longus. It usually hits runners and jumpers who push themselves too hard or ramp up their training way too fast. Jumping straight into longer or more intense workouts without building a base is a recipe for trouble. Training on uneven fields or hard asphalt with shoes that lack cushion makes things much worse. Common body mechanics linked to this include flat feet, overpronation, and uneven leg lengths[3,1].

EPIDEMIOLOGY

Roughly 13.6% to 20% of runners deal with MTSS, and that number jumps to 35% for military recruits. Both personal and environmental factors play a role. On the personal side, things like being female, having had shin splints before, a higher BMI, flat arches, limited ankle flexibility, or tight hips can increase vulnerability. On the environmental side, the surface you train on matters a ton. Sudden changes in how often, how long, or how hard you train put massive strain on the shin bone, and playing in bad footwear makes it even riskier[3,1].

HISTORY AND PHYSICAL EXAMINATION

Diagnosing MTSS reliably comes down to a thorough patient history, physical checks, and imaging like an MRI. When talking to a player, you usually hear about pain along the lower two-thirds of the inner shin that flares up during or after workouts, calms down with rest, and doesn't involve any weird numbness or tingling in the feet. Physical exams focus on feeling around the lower leg using specific tests. The Shin Palpation Test checks for familiar pain along the inner edge of the shin over a stretch longer than 5 cm. The Shin Edema Test involves pressing firmly on the inner shin for 5 seconds on both legs to check for any pitting swelling. If needed, an MRI can pick up bone marrow swelling and periosteal edema[10].

NEED OF THE STUDY

Football is brutal on the body, packed with non-stop sprinting, hard cuts, and heavy jumps that put intense pressure on the lower legs. Because of this, players deal with MTSS all the time, yet we are really lacking specific data on how it affects intermediate players.

While there is plenty of research on how shin splints hit marathon runners or soldiers, intermediate footballers are practically ignored. This is worrying because players at this level are right in a critical growth phase where training intensity and hours usually spike, putting them right in the danger zone for overuse injuries. If nobody catches it early, it doesn't just mean a bit of soreness—it can ruin their season, hurt their performance, and even turn into full-blown stress fractures.

Figure out the actual prevalence gives coaches and trainers the tools to spot problems early and teach players not to brush off pain. This study is crucial for mapping out risk factors and catching MTSS before it derails a player's career.

AIM

To assess the prevalence of medial tibial stress syndrome in intermediate male football players.

OBJECTIVES

- 1. To quantify the prevalence of MTSS among intermediate male football players using a questionnaire based on the MTSS score scale.
- 2. To evaluate the effect of MTSS on football players' training regimens using the ACWR.
- 3. To identify common clinical presentations of MTSS symptoms (such as pain intensity and focal or diffuse tenderness along the shin) using standardized diagnostic tests like the Shin Palpation Test.

REVIEW OF LITERATURE

1.) Amaranta Orejel Bustos et al. (2021) looked into overuse injuries of the musculoskeletal system, pointing out that researchers often use inconsistent methods to study risk factors. They stressed the need for a multi-dimensional approach covering everything from biology and lifestyle to workplace stressors to truly understand overuse damage.

2.) Mohmmed A. Saad et al. (2025) ran a scoping review on MTSS epidemiology and biomechanics, analyzing 37 studies. They found that athletes made up 67.6% of study participants. The highest reported prevalence was 69.5% among recreational runners in India, while a German study found an incidence of 35.7%. Their findings showed that higher BMI can drag out recovery times, while having more athletic experience sometimes lowers the risk.

3.) Nikita S. Deshmukh and Pratik Phansopkar (2022) published a review highlighting that MTSS is super common in runners and athletes. They noted that conservative care like stretching, strengthening, and orthotics helps, while newer options like shockwave therapy can also ease pain.

4.) Melanie Franklyn and Barry Oakes (2015) examined the causes of MTSS, concluding it is an overuse fatigue injury involving periostitis and microscopic cracks in the cortical bone. They noted that while risk factors are well-studied, the exact mechanical triggers still need more longitudinal tracking.

5.) Peter Francis et al. (2018) looked at lower limb running injuries across studies and found that the knee (28%), ankle-foot (26%), and shank (16%) take the hardest hit, with patellofemoral pain and MTSS being among the top specific issues.

6.) Taylor Miners et al. (2025) explored how tweaking running technique—like dropping speed by 10% or bumping up cadence—can significantly cut down vertical loads on the tibia.

7.) Joshua P. M. Mattock, Julie R. Steele et al. (2021) reviewed muscle and tendon traits linked to MTSS, finding that smaller lower leg muscle girth and high soleus muscle activity during push-off are key risk factors.

8.) Tudor Vladimir Gurau et al. (2023) compared injuries in professional versus amateur footballers, finding that amateurs dealt with more traumatic mechanisms and higher rates of severe injuries compared to pros.

9.) Alexandre Dias Lopes et al. (2023) reviewed running biomechanics and concluded that very little solid evidence directly links specific biomechanical shifts to running injuries due to inconsistent study methods.

10.) Tricia J. Hubbard et al. (2009) found that a past history of MTSS and years of running experience were the biggest predictors, accounting for 44% of the variance in who gets injured.

11.) Amir Human Hoveidaei et al. (2025) reviewed stress fractures in soccer players, noting that players face high risks due to repetitive forces and a mix of personal and training factors.

12.) Professional soccer players miss an average of 37 days per season due to injuries. Repeated microtrauma weakens the bone if bone breakdown outpaces new bone growth.

13.) Debbie Craig (2016) explored advances in understanding MTSS, emphasizing that while symptoms are clear, the exact forces creating the injury still need more research.

14.) Fan Yang et al. (2026) studied football boot designs, showing how stud patterns and outsole stiffness directly affect rotational traction and lower limb injury risks.

15.) Sylvain Blanchard et al. (2018) analyzed soccer shoe ergonomics, recommending arch supports and moderate cleat resistance to protect knees and ankles.

16.) Andrew Omojoefodun and Victor Henry (2024) found that 94% of football players believe bad boots cause injuries, yet 63% never got medical advice on what shoes to wear.

17.) Zakhariya H. et al. (2022) noted that older male players with high BMI playing on natural grass had higher injury risks.

18.) Nikit Venishetty et al. (2024) reported that NFL athletes suffered more severe injuries on artificial turf compared to natural grass.

19.) Micah S. Ngatuvai et al. (2022) compared ACL injuries across playing surfaces, highlighting mixed results that warrant more safety studies.

20.) Timothy A. Reiad et al. (2025) analyzed 20 years of data comparing orthopedic injuries on turf versus grass across multiple sports.

21.) Andrea Demeco et al. (2025) reviewed soccer footwear as a vital biomechanical interface affecting injury risk.

22.) Shane Malone et al. (2017) found that high weekly training loads and sudden workload spikes significantly increase injury risk in professional soccer players.

METHODOLOGY AND MATERIALS

- Study type: Observational study.
- Study design: Survey study.
- Sample size: 130 participants.
- Target population: Intermediate male football players aged 18 to 22 years.
- Study duration: 6 months.
- Materials used: Informed consent forms, questionnaires, writing instruments, data collection sheets.

OUTCOME MEASURES

- 1. Medial Tibial Stress Syndrome Score Questionnaire (Marinus Winters et al., 2016): Condition-specific PROM with good test-retest reliability (ICC = 0.82–0.88) and moderate-to-strong construct validity (0.71).
- 2. Shin Palpation Test (SPT): Primary clinical diagnostic maneuver for MTSS with near-perfect inter-rater reliability (kappa = 0.89–1.00) and high specificity.
- 3. Acute Chronic Workload Ratio (ACWR): Evaluates weekly training loads and sudden load spikes relative to chronic conditioning baselines.

INCLUSION CRITERIA

- - Intermediate male football players actively engaged in structured training or competition (minimum 3–4 sessions weekly, 2–3 hours per session).
- - Age group: 18 to 22 years, ensuring sample homogeneity.
- - Provision of written informed consent.

EXCLUSION CRITERIA

- - History or current diagnosis of tibial stress fractures.
- - Existing lower limb musculoskeletal injuries or deformities.
- - Prior history of lower limb surgery.
- - Inability or unwillingness to complete study requirements.

PROCEDURE

- 1. Institutional ethical committee approval was secured prior to study initiation.
- 2. The aims and objectives of the research were detailed to prospective participants.
- 3. Eligible participants meeting inclusion criteria were enrolled.
- 4. Signed informed consent was obtained from each participant.
- 5. The MTSS Score questionnaire was administered to quantify symptom severity.
- 6. The Shin Palpation Test was performed as a standardized diagnostic maneuver.
- 7. Assessment data were systematically compiled and organized.

- 8. Statistical analysis was conducted based on gathered participant responses.

DATA ANALYSIS AND INTERPRETATION

Data were analysed using IBM SPSS Statistics for Windows, Version 26.0. The analysis-ready dataset was screened for completeness, valid coding, and consistency before statistical analysis. All 130 participants had complete data for the variables included in the final analyses; therefore, no imputation or case deletion for missing data was required. Continuous variables were summarized using mean and standard deviation (SD) when distributional characteristics supported parametric presentation and median and interquartile range (IQR) for skewed, discrete, or ordinal variables. Categorical variables were summarized as frequencies and percentages.

Participant-level prevalence of medial tibial stress syndrome (MTSS), side-specific positive Shin Palpation Tests, bilateral involvement, and training limitation were expressed as proportions with exact 95% binomial confidence intervals where available. Distributional assumptions for continuous variables were assessed using Shapiro–Wilk tests together with inspection of the data characteristics. Homogeneity of variance for variables analysed parametrically was assessed using the median-centred Brown–Forsythe test.

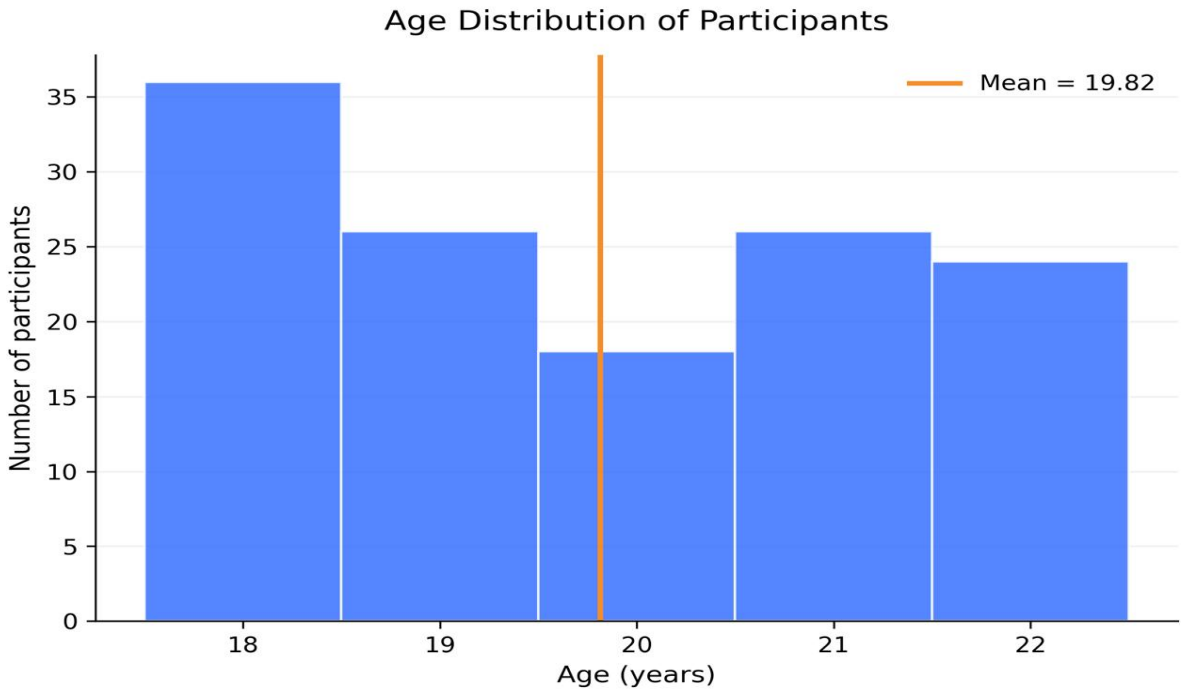
Between-group comparisons according to MTSS status were performed using Welch's independent-samples t test for week 1, week 2, week 3, coupled chronic, and uncoupled chronic training-load variables. Hedges' g was reported as the corresponding standardized effect size. Mann–Whitney U tests were used for age, training days per week, rating of perceived exertion (RPE), week 4 acute training load, coupled acute:chronic workload ratio (ACWR), and uncoupled ACWR. Rank-biserial correlation was reported as the effect size for these comparisons.

Associations between MTSS status and categorical player or training characteristics were examined using Pearson's chi-square test. When expected-frequency assumptions were inadequate, Fisher's exact test with Monte Carlo simulation using 10,000 replicates was used. Cramér's V quantified the strength of categorical associations. All statistical tests were two-tailed, 95% confidence intervals were used where available, and statistical significance was set at $p < .05$.

Table 1: Participant Characteristics

Characteristic	Category / Statistic	n
Age (years), Mean (SD)	19.82 (1.49)	130
Age (years), Median (IQR)	20 (3)	130

Characteristic	Category / Statistic	n	%
Sex	Male	130	100
Dominant leg	Right	97	74.62
Dominant leg	Left	33	25.38
Playing position	Defender	27	20.77
Playing position	Forward	42	32.31
Playing position	Goalkeeper	18	13.85
Playing position	Midfielder	43	33.08
Level of play	Academy	18	13.85
Level of play	College	37	28.46
Level of play	District	57	43.85
Level of play	University	18	13.85
Football experience	2–3 years	14	10.77
Football experience	3–4 years	35	26.92
Football experience	>4 years	81	62.31


Age Distribution of Participants
Mean = 19.82
Number of participants
Age (years)
0
5
10
15
20
25
30
35
18
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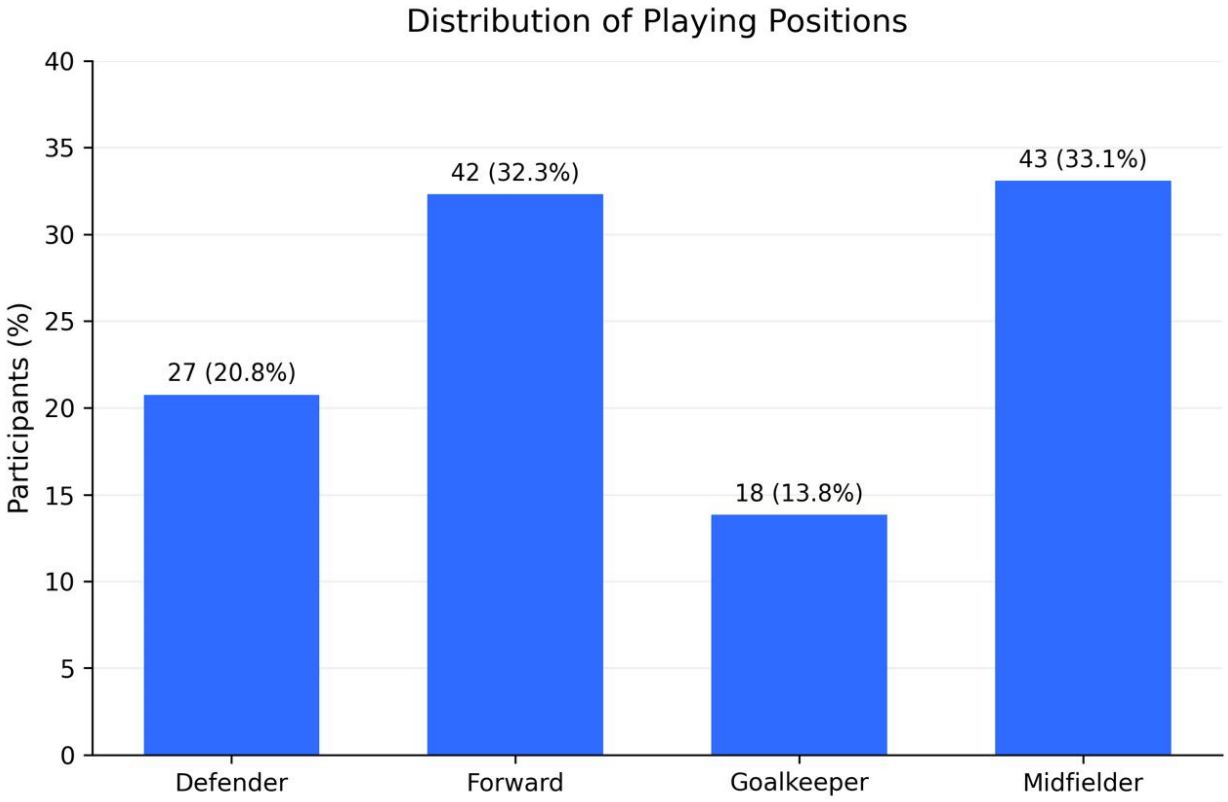
Distribution of Playing Positions
Participants (%)
27 (20.8%)
42 (32.3%)
18 (13.8%)
43 (33.1%)
Defender
Forward
Goalkeeper
Midfielder
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20
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35
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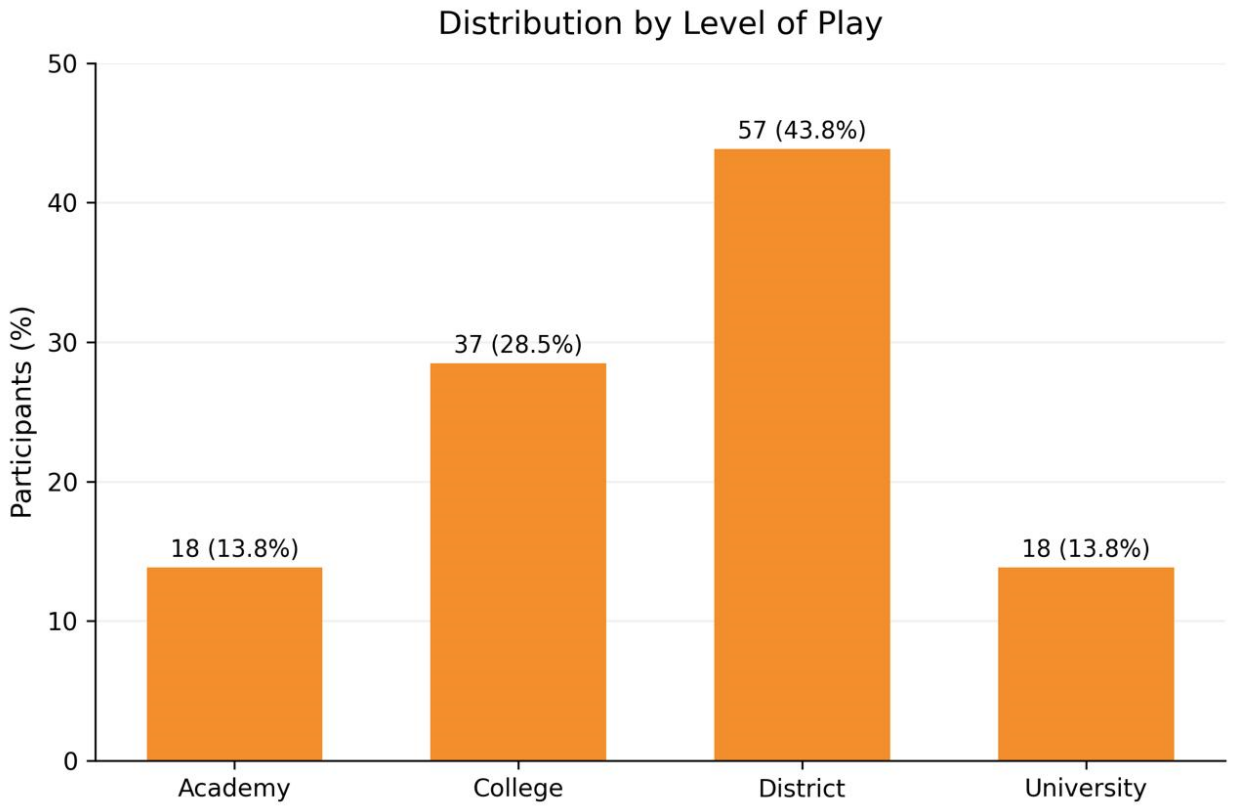
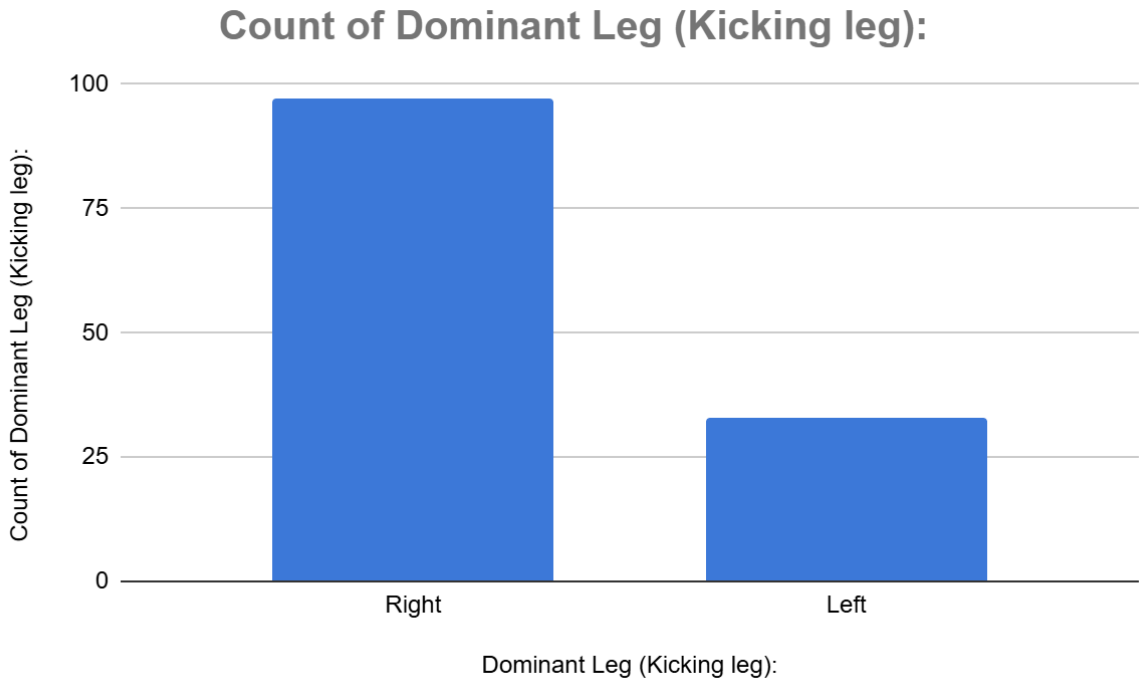


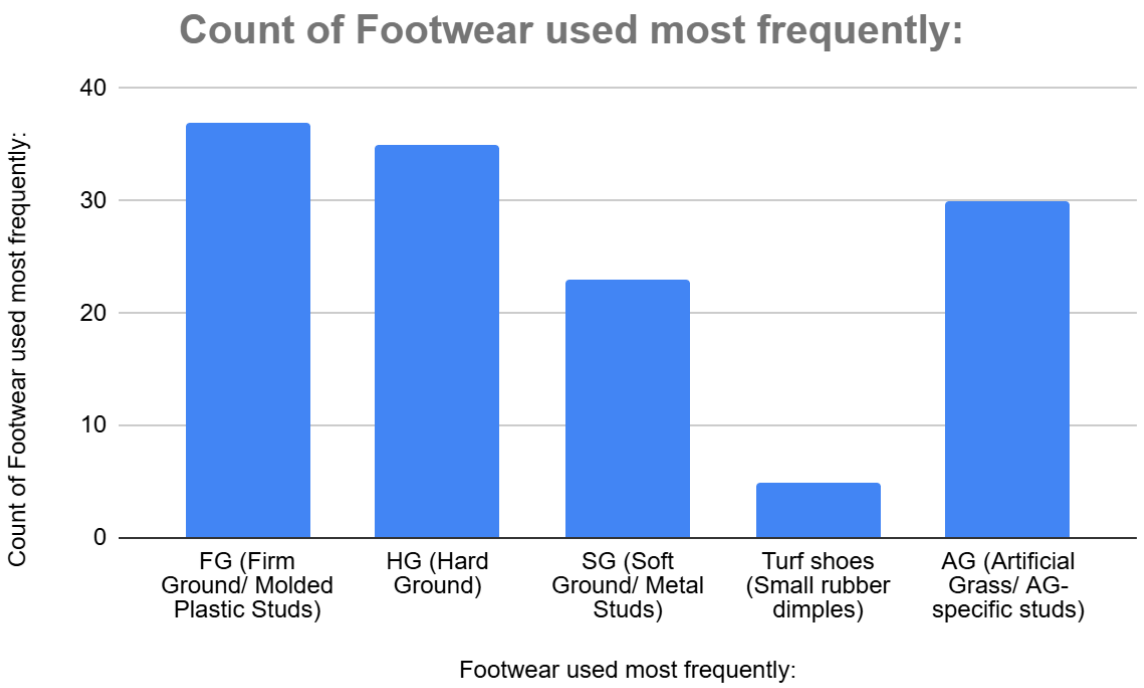


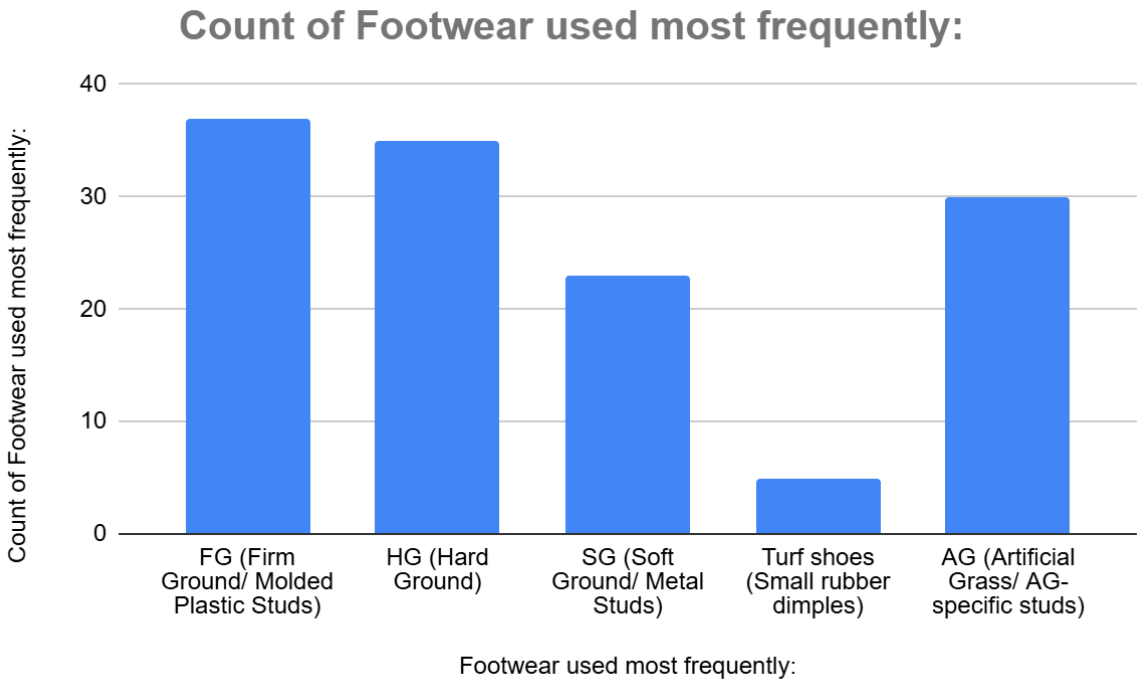
Interpretation: Participants were 18–22 years old, with a mean age of 19.82 years. All participants were male; most were right-leg dominant, higher number of midfielders and forward position players and district-level players constituted the largest competitive-level category.

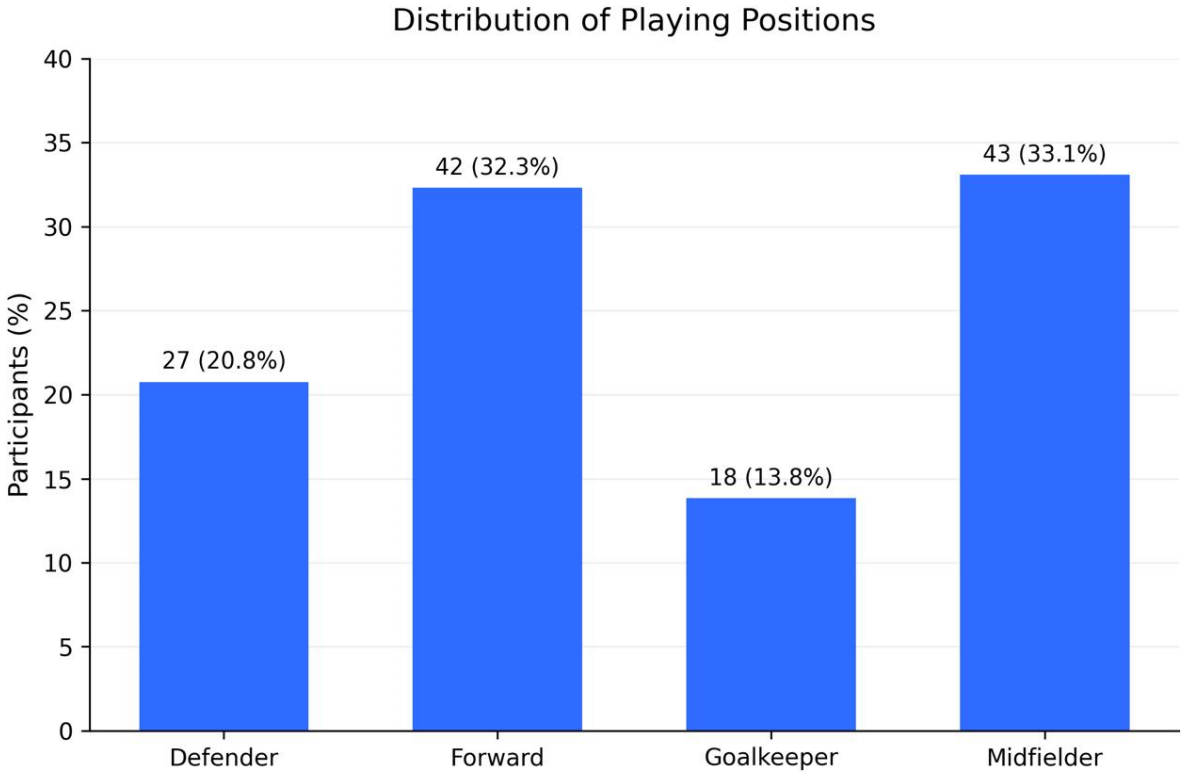
Table 2. Training Characteristics:

Characteristic	Category / Statistic	n
Training days/week, Median (IQR)	6 (0.75)	130
RPE score, Median (IQR)	5 (3)	130

Characteristic	Category / Statistic	n	%
Practice duration	60 minutes (1 hour)	18	13.85
Practice duration	60–120 minutes (1–2 hours)	44	33.85
Practice duration	120–180 minutes (2–3 hours)	53	40.77
Practice duration	>180 minutes (>3 hours)	15	11.54
Rest breaks/session	1	23	17.69
Rest breaks/session	2	27	20.77
Rest breaks/session	3	15	11.54
Rest breaks/session	4	51	39.23
Rest breaks/session	>4	14	10.77
Rest-break duration	2–4 minutes	88	67.69
Rest-break duration	4–6 minutes	32	24.62
Rest-break duration	6–8 minutes	5	3.85
Rest-break duration	8–10 minutes	5	3.85
Footwear	AG	30	23.08
Footwear	FG	37	28.46
Footwear	HG	35	26.92
Footwear	SG	23	17.69
Footwear	Turf shoes	5	3.85
Playing surface	Natural grass	58	44.62
Playing surface	Artificial turf	37	28.46
Playing surface	Concrete or hard ground	28	21.54
Playing surface	Mud field/uneven ground	7	5.38





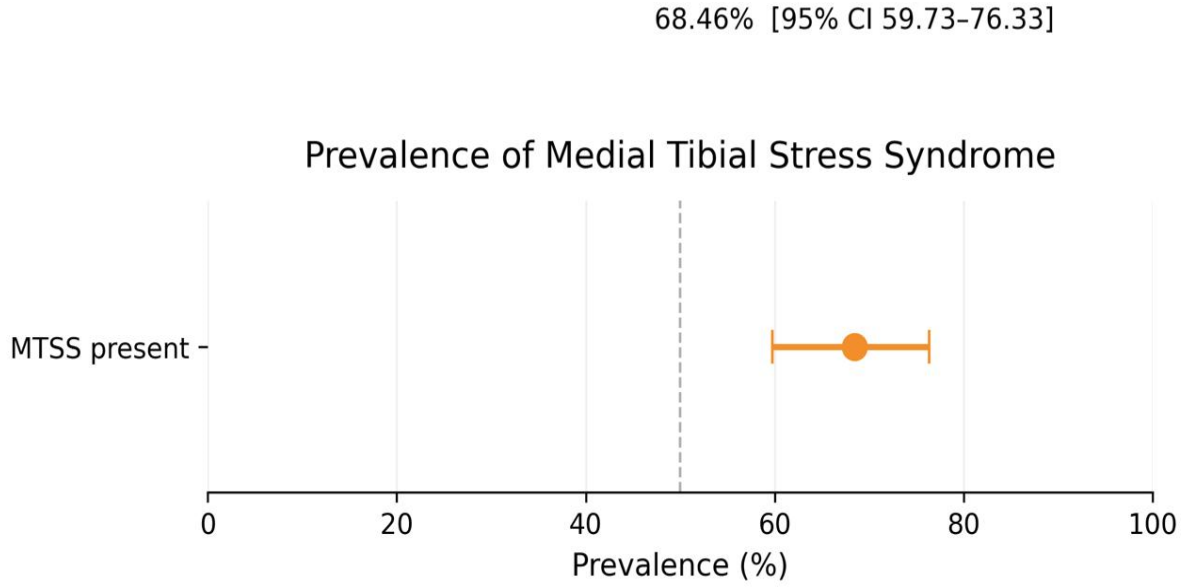


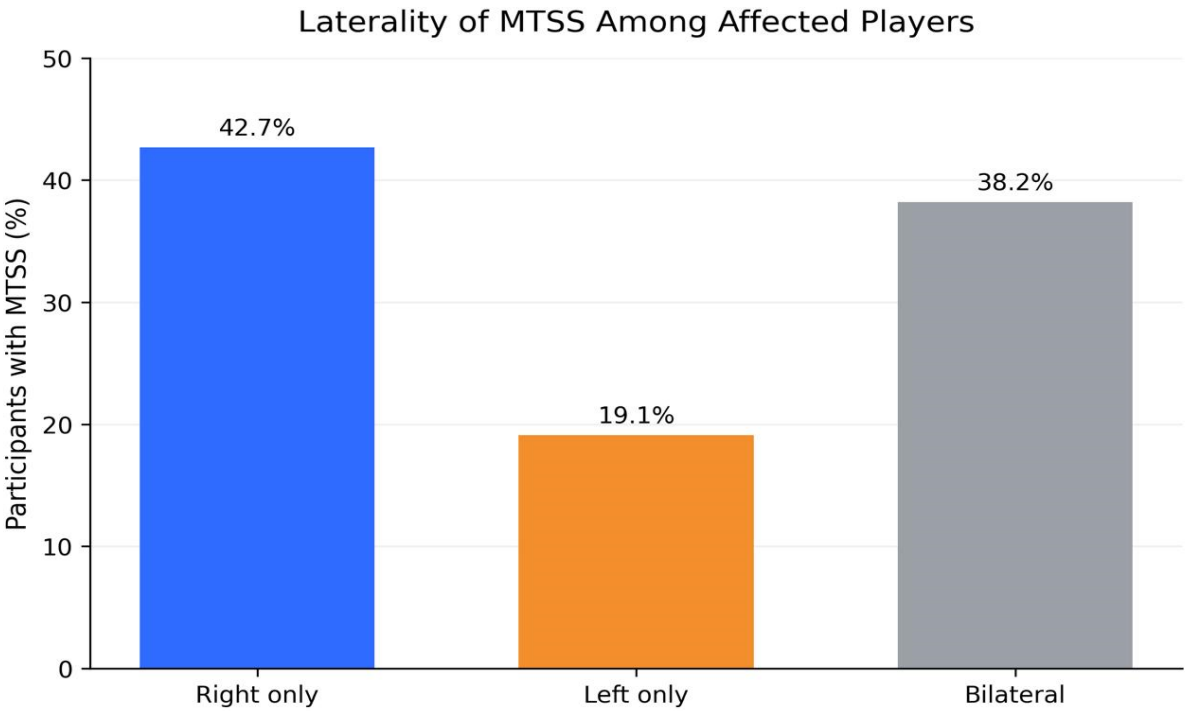
Interpretation: Players generally trained frequently, with a median of 6 training days per week. The most common practice duration was 2–3 hours, natural grass was the most frequently reported playing surface, and firm-ground footwear was the most common footwear category.

Table 3: Prevalence and Laterality of Medial Tibial Stress Syndrome

Outcome	**n/N**	**%**	**95% CI**
MTSS present	89/130	68.46	59.73–76.33
Positive shin palpation test-right	72/130	55.38	46.42–64.10

Outcome	n/N	%	95% CI
Positive shin palpation test-left	51/130	39.23	30.79–48.18
Bilateral involvement	34/130	26.15	18.84–34.58
Right-only involvement	38/130	29.23	NR
Left-only involvement	17/130	13.08	NR
No involvement	41/130	31.54	NR

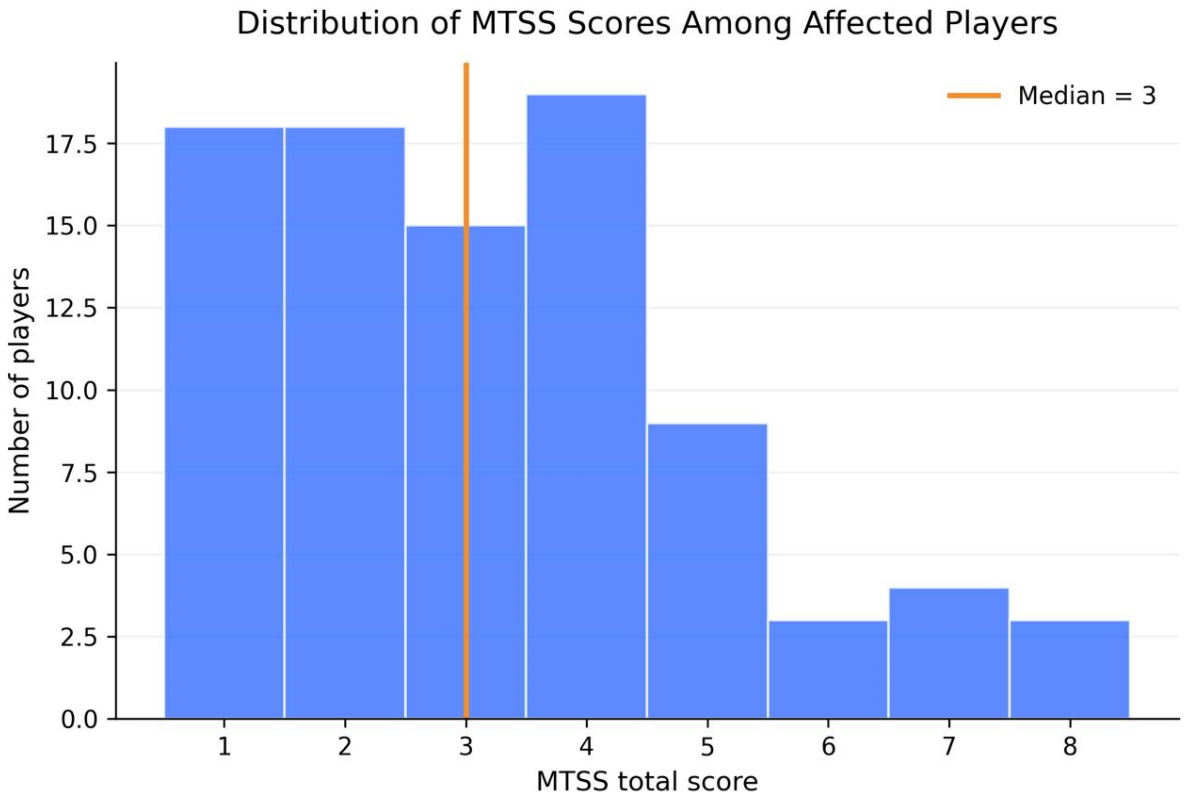




Interpretation. MTSS was identified in 68.46% of the football players. Right-sided involvement was more frequent than left-sided involvement, while 26.15% of the total sample demonstrated bilateral involvement.

Table 4: Clinical Severity Among Players With MTSS

Measure	n	Median	IQR	Minimum–Maximum
Activity-limitation score	89	0	1	0–2
Sport-pain score	89	1	1	0–2
Walking-pain score	89	1	1	0–2
Rest-pain score	89	1	1	0–2
MTSS total score	89	3	2	1–8



Interpretation. Among players with MTSS, the median total MTSS score was 3 (IQR = 2). Pain during sport was the most prominent symptom component, whereas activity limitation was generally lower.

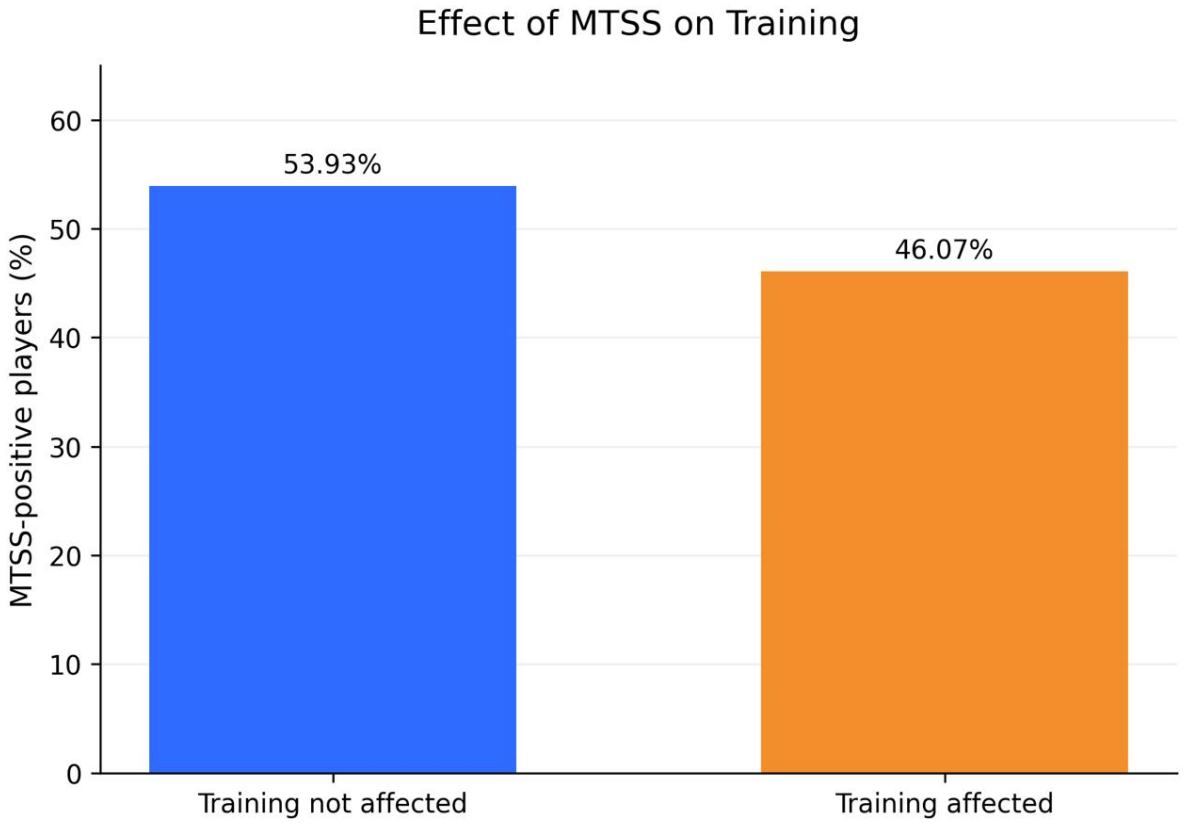
Table 5. Clinical Presentation Among Players With MTSS

Clinical feature	Category	n	%
Activity limitation	Performs all usual sporting activities	48	53.93
Activity limitation	Forced to do less usual sporting activity	35	39.33
Activity limitation	Forced to perform alternative sporting activities only	6	6.74
Pain during sport	No pain	2	2.25
Pain during sport	Some pain	62	69.66
Pain during sport	A lot of pain	25	28.09
Pain while walking	No pain	24	26.97
Pain while walking	Some pain	57	64.04
Pain while walking	A lot of pain	8	8.99
Pain at rest	Not painful	40	44.94
Pain at rest	Sensitive	40	44.94
Pain at rest	Painful	8	8.99
Pain at rest	Very painful	1	1.12
Laterality	Right only	38	42.7
Laterality	Left only	17	19.1
Laterality	Bilateral	34	38.2

Interpretation. Pain during sport was reported by nearly all MTSS-positive players, while walking and rest symptoms were less frequent. Right-only involvement was the most common laterality pattern among affected players, followed by bilateral involvement.

Table 6. Effect of MTSS on Training

Training impact	n/N	%	95% CI
Training affected	41/89	46.07	35.44–56.96
Training not affected	48/89	53.93	NR
Reduced usual sporting activities	35/89	39.33	NR
Alternative sporting activities only	Jun-89	6.74	NR



Interpretation: MTSS affected training in 46.07% of affected players. Most training limitations involved reducing usual sporting activity, while a smaller proportion required alternative sporting activities only.

Table 7. Normality Assessment and Final Test Selection

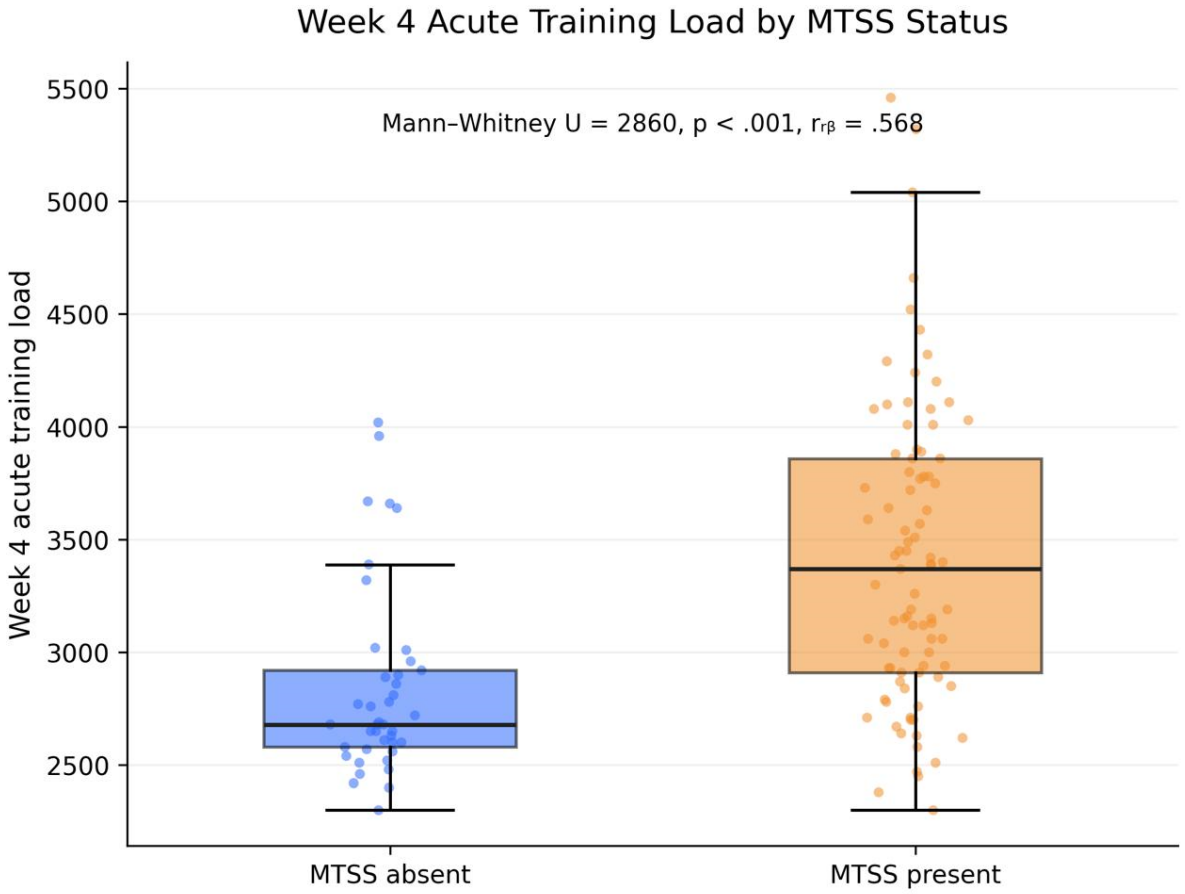
Variable	MTSS Absent: Shapiro–Wilk W (p)	MTSS Present: Shapiro–Wilk W (p)
Age	0.7271 (<.001)	0.8790 (<.001)
Training days/week	0.7279 (<.001)	0.5575 (<.001)
RPE score	0.9148 (.005)	0.9261 (<.001)
Week 1 load	0.9814 (.728)	0.9776 (.128)
Week 2 load	0.9608 (.168)	0.9924 (.895)
Week 3 load	0.9762 (.535)	0.9858 (.447)
Week 4 acute load	0.8247 (<.001)	0.9569 (.005)
Coupled chronic load	0.9745 (.479)	0.9650 (.017)
Uncoupled chronic load	0.9772 (.570)	0.9868 (.507)
Coupled ACWR	0.8145 (<.001)	0.9713 (.046)
Uncoupled ACWR	0.7825 (<.001)	0.9473 (.001)

Interpretation: Distributional assessment supported non-parametric comparisons for age, training frequency, RPE, week 4 acute load, and both ACWR measures. Welch t tests were retained for the remaining workload measures.

Table 8. Continuous Characteristics According to MTSS Status

Variable	MTSS Absent	MTSS Present	Test statistic	df	p	Effect size	95% CI for group difference
Age, years	18 (2)	20 (2)	U = 2800.5		<.001	r_rb = .535	1 to 2
Training days/week	6 (1)	6 (0)	U = 2024.0		0.204	r_rb = .109	0 to 0
RPE score	3 (2)	6 (3)	U = 3101.0		<.001	r_rb = .700	2 to 3
Week 1 load	2750.73 (169.68)	2622.47 (175.24)	t = -3.9633	80.165	<.001	g = -0.735	-192.66 to -63.86
Week 2 load	2718.54 (148.59)	2624.27 (163.91)	t = -3.2518	85.244	0.002	g = -0.588	-151.90 to -36.63
Week 3 load	2716.10 (179.48)	2635.96 (168.60)	t = -2.4108	73.6	0.018	g = -0.463	-146.39 to -13.90
Week 4 acute load	2680 (340)	3370 (950)	U = 2860.0		<.001	r_rb = .568	320 to 740
Coupled chronic load	2756.83 (89.86)	2823.32 (116.30)	t = 3.5594	98.808	<.001	g = .608	29.42 to 103.55

Variable	MTSS Absent	MTSS Present	Test statistic	df	p	Effect size	95% CI for group difference
Uncoupled chronic load	2728.45 (114.91)	2627.56 (130.12)	t = -4.4573	87.359	<.001	g = -0.799	-145.87 to -55.90
Coupled ACWR	0.99 (0.10)	1.19 (0.30)	U = 2850.0		<.001	r_rb = .562	0.10 to 0.23
Uncoupled ACWR	0.99 (0.12)	1.26 (0.45)	U = 2852.0		<.001	r_rb = .563	0.14 to 0.33

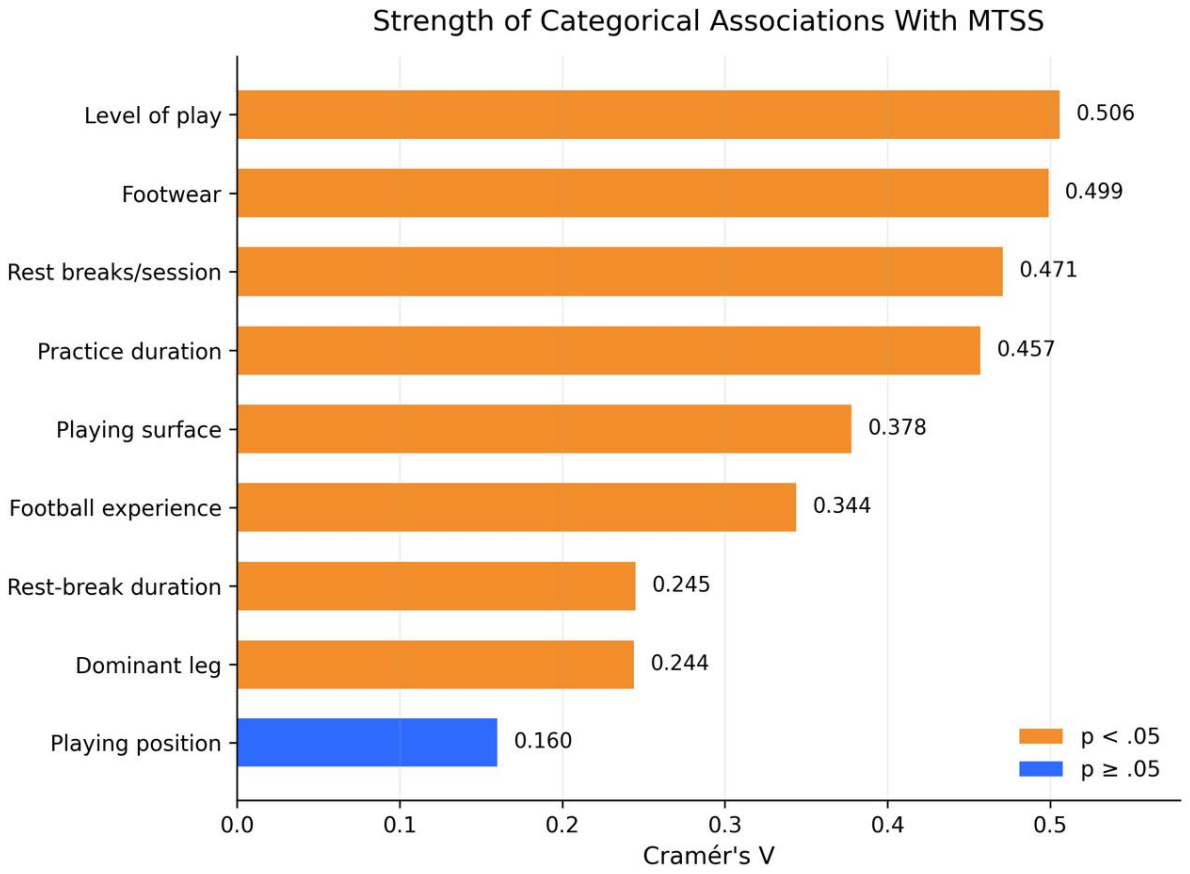


Interpretation: Players with MTSS were older and reported higher RPE, week 4 acute load, and both ACWR measures, with moderate-to-large rank-biserial effects. Week 1–3 and uncoupled chronic loads were lower in the MTSS-present group, whereas coupled chronic load was higher. Training days per week did not show statistically significant evidence of a difference between MTSS groups.

Table 9. Categorical Factors Associated With MTSS

Variable	Category	MTSS Present, n/N (%)	Test	p	Cramér's V
Dominant leg	Left	29/33 (87.88)	$\chi^2(1) = 7.7228$	0.005	0.244
Dominant leg	Right	60/97 (61.86)	$\chi^2(1) = 7.7228$	0.005	0.244
Playing position	Defender	17/27 (62.96)	$\chi^2(3) = 3.3208$	0.345	0.16
Playing position	Forward	26/42 (61.90)	$\chi^2(3) = 3.3208$	0.345	0.16
Playing position	Goalkeeper	15/18 (83.33)	$\chi^2(3) = 3.3208$	0.345	0.16
Playing position	Midfielder	31/43 (72.09)	$\chi^2(3) = 3.3208$	0.345	0.16
Level of play	Academy	9/18 (50.00)	$\chi^2(3) = 33.3184$	<.001	0.506
Level of play	College	14/37 (37.84)	$\chi^2(3) = 33.3184$	<.001	0.506
Level of play	District	52/57 (91.23)	$\chi^2(3) = 33.3184$	<.001	0.506
Level of play	University	14/18 (77.78)	$\chi^2(3) = 33.3184$	<.001	0.506
Football experience	2–3 years	5/14 (35.71)	$\chi^2(2) = 15.4213$	<.001	0.344
Football experience	3–4 years	19/35 (54.29)	$\chi^2(2) = 15.4213$	<.001	0.344
Football experience	>4 years	65/81 (80.25)	$\chi^2(2) = 15.4213$	<.001	0.344
Practice duration	60 minutes	9/18 (50.00)	$\chi^2(3) = 27.1756$	<.001	0.457
Practice duration	60–120 minutes	20/44 (45.45)	$\chi^2(3) = 27.1756$	<.001	0.457
Practice duration	120–180 minutes	45/53 (84.91)	$\chi^2(3) = 27.1756$	<.001	0.457
Practice duration	>180 minutes	15/15 (100.00)	$\chi^2(3) = 27.1756$	<.001	0.457
Rest breaks/session	1	6/23 (26.09)	$\chi^2(4) = 28.7834$	<.001	0.471

Variable	Category	MTSS Present, n/N (%)	Test	p	Cramér's V
Rest breaks/session	2	18/27 (66.67)	$\chi^2(4) = 28.7834$	<.001	0.471
Rest breaks/session	3	13/15 (86.67)	$\chi^2(4) = 28.7834$	<.001	0.471
Rest breaks/session	4	38/51 (74.51)	$\chi^2(4) = 28.7834$	<.001	0.471
Rest breaks/session	>4	14/14 (100.00)	$\chi^2(4) = 28.7834$	<.001	0.471
Rest-break duration	2–4 minutes	67/88 (76.14)	Fisher exact, simulated	0.031	0.245
Rest-break duration	4–6 minutes	16/32 (50.00)	Fisher exact, simulated	0.031	0.245
Rest-break duration	6–8 minutes	3/5 (60.00)	Fisher exact, simulated	0.031	0.245
Rest-break duration	8–10 minutes	3/5 (60.00)	Fisher exact, simulated	0.031	0.245
Footwear	AG	26/30 (86.67)	$\chi^2(4) = 32.3667$	<.001	0.499
Footwear	FG	17/37 (45.95)	$\chi^2(4) = 32.3667$	<.001	0.499
Footwear	HG	33/35 (94.29)	$\chi^2(4) = 32.3667$	<.001	0.499
Footwear	SG	12/23 (52.17)	$\chi^2(4) = 32.3667$	<.001	0.499
Footwear	Turf shoes	1/5 (20.00)	$\chi^2(4) = 32.3667$	<.001	0.499
Playing surface	Artificial turf	29/37 (78.38)	Fisher exact, simulated	<.001	0.378
Playing surface	Concrete or hard ground	26/28 (92.86)	Fisher exact, simulated	<.001	0.378
Playing surface	Mud field/uneven ground	5/7 (71.43)	Fisher exact, simulated	<.001	0.378
Playing surface	Natural grass	29/58 (50.00)	Fisher exact, simulated	<.001	0.378



Interpretation. Statistical evidence of association with MTSS was detected for dominant leg, level of play, football experience, practice duration, rest breaks per session, rest-break duration, footwear, and playing surface. The largest associations were observed for level of play, footwear, rest breaks per session, and practice duration. Playing position was not significantly associated with MTSS.

RESULTS

Analysed Sample and Participant Characteristics

A total of 130 intermediate football players were included in the final analysis, with complete data for all variables used in the statistical analyses. All participants were male. Mean age was 19.82 years (SD = 1.49), with an observed range of 18–22 years. Right-leg dominance was reported by 97 participants (74.62%), whereas 33 (25.38%) were left-leg dominant.

Midfielders constituted 33.08% of the sample, forwards 32.31%, defenders 20.77%, and goalkeepers 13.85%. The largest proportion of players competed at district level (43.85%), followed by college level (28.46%), while academy and university players each represented 13.85%. Most participants had more than four years of football experience (62.31%).

Players trained a median of 6 days per week (IQR = 0.75), and median RPE was 5 (IQR = 3). The most common practice duration was 120–180 minutes per session (40.77%). Natural grass was the most frequently reported playing surface (44.62%), followed by artificial turf (28.46%), concrete or hard ground (21.54%), and mud or uneven ground (5.38%).

Prevalence of Medial Tibial Stress Syndrome

MTSS was identified in 89 of 130 players, corresponding to a participant-level prevalence of 68.46%, 95% CI [59.73, 76.33]. The remaining 41 participants (31.54%) were classified as MTSS absent.

A positive right-sided Shin Palpation Test was observed in 72 participants (55.38%), 95% CI [46.42, 64.10], whereas 51 participants (39.23%) demonstrated a positive left-sided test, 95% CI [30.79, 48.18]. Bilateral involvement occurred in 34 participants (26.15% of the entire sample), 95% CI [18.84, 34.58].

Among the 89 MTSS-positive participants, 38 (42.70%) had right-only involvement, 17 (19.10%) had left-only involvement, and 34 (38.20%) demonstrated bilateral involvement.

Clinical Presentation and Severity

Among participants with MTSS, the median total MTSS score was 3 (IQR = 2), with scores ranging from 1 to 8. Median activity-limitation score was 0 (IQR = 1), median sport-pain score was 1 (IQR = 1), median walking-pain score was 1 (IQR = 1), and median rest-pain score was 1 (IQR = 1).

Pain during sporting activity was common among affected players. Only 2 of 89 participants (2.25%) reported no pain during sport, whereas 62 (69.66%) reported some pain and 25 (28.09%) reported a lot of pain. For walking-related symptoms, 24 participants (26.97%) reported no pain, 57 (64.04%) reported some pain, and 8 (8.99%) reported a lot of pain.

At rest, 40 players (44.94%) reported no pain and another 40 (44.94%) reported sensitivity. Eight participants (8.99%) reported painful symptoms and one participant (1.12%) reported very painful symptoms.

Effect of MTSS on Training

Among the 89 players with MTSS, training was affected in 41 participants (46.07%), 95% CI [35.44, 56.96]. Forty-eight participants (53.93%) continued their usual sporting activities.

Of the affected participants, 35 of 89 (39.33%) reported being forced to perform less of their usual sporting activity because of shin pain, while 6 of 89 (6.74%) were restricted to alternative sporting activities.

Continuous Characteristics According to MTSS Status

Age differed significantly between MTSS groups. Players with MTSS had a median age of 20 years (IQR = 2) compared with 18 years (IQR = 2) among players without MTSS, $U = 2800.5$, $p < .001$, rank-biserial $r = .535$, with a 95% location-shift CI [1, 2].

The number of training days per week did not show statistically significant evidence of a difference between MTSS-present and MTSS-absent participants, with both groups having a median of 6 training days per week, $U = 2024.0$, $p = .204$, rank-biserial $r = .109$.

RPE was higher among players with MTSS. The MTSS-present group had a median RPE of 6 (IQR = 3) compared with 3 (IQR = 2) in the MTSS-absent group, $U = 3101.0$, $p < .001$, rank-biserial $r = .700$, 95% CI for the location shift [2, 3].

For weekly training loads, mean week 1 load was lower in the MTSS-present group than in the MTSS-absent group, 2622.47 (SD = 175.24) versus 2750.73 (SD = 169.68), respectively. The mean difference was −128.26, 95% CI [−192.66, −63.86], Welch's $t(80.165) = -3.9633$, $p < .001$, Hedges' $g = -0.735$.

Week 2 training load was likewise lower among MTSS-positive players, 2624.27 (SD = 163.91) compared with 2718.54 (SD = 148.59), mean difference = −94.27, 95% CI [−151.90, −36.63], Welch's $t(85.244) = -3.2518$, $p = .002$, Hedges' $g = -0.588$. Week 3 load was also lower in the MTSS-present group, 2635.96 (SD = 168.60) versus 2716.10 (SD = 179.48), mean difference = −80.14, 95% CI [−146.39, −13.90], Welch's $t(73.600) = -2.4108$, $p = .018$, Hedges' $g = -0.463$.

In contrast, week 4 acute load was higher among MTSS-positive participants. Median week 4 acute load was 3370 (IQR = 950) in the MTSS-present group compared with 2680 (IQR = 340) in the MTSS-absent group, $U = 2860.0$, $p < .001$, rank-biserial $r = .568$, 95% CI for the location shift [320, 740].

Mean coupled chronic load was higher among players with MTSS, 2823.32 (SD = 116.30) versus 2756.83 (SD = 89.86), mean difference = 66.49, 95% CI [29.42, 103.55], Welch's $t(98.808) = 3.5594$, $p < .001$, Hedges' $g = .608$. Conversely, uncoupled chronic load was lower in the MTSS-present group, 2627.56 (SD = 130.12) versus 2728.45 (SD = 114.91), mean difference = −100.89, 95% CI [−145.87, −55.90], Welch's $t(87.359) = -4.4573$, $p < .001$, Hedges' $g = -0.799$.

Both ACWR measures were higher among players with MTSS. Coupled ACWR had a median of 1.19 (IQR = 0.30) in the MTSS-present group compared with 0.99 (IQR = 0.10) in the MTSS-absent group, $U = 2850.0$, $p < .001$, rank-biserial $r = .562$, 95% CI [0.10, 0.23]. Uncoupled ACWR was similarly higher, with medians of 1.26 (IQR = 0.45) and 0.99 (IQR = 0.12), respectively, $U = 2852.0$, $p < .001$, rank-biserial $r = .563$, 95% CI [0.14, 0.33].

Categorical Characteristics Associated With MTSS

Dominant leg was significantly associated with MTSS status, $\chi^2(1) = 7.7228$, $p = .005$, Cramér's $V = .244$. MTSS was present in 87.88% of left-leg-dominant players compared with 61.86% of right-leg-dominant players.

Playing position was not significantly associated with MTSS status, $\chi^2(3) = 3.3208$, $p = .345$, Cramér's $V = .160$.

Level of play showed a significant association with MTSS, $\chi^2(3) = 33.3184$, $p < .001$, Cramér's $V = .506$. MTSS prevalence within the respective categories was 91.23% among district-level players, 77.78% among university players, 50.00% among academy players, and 37.84% among college-level players.

Football experience was also significantly associated with MTSS, $\chi^2(2) = 15.4213$, $p < .001$, Cramér's $V = .344$. MTSS was present in 80.25% of players with more than four years of football experience, compared with 54.29% of those with 3–4 years and 35.71% of those with 2–3 years of experience.

Practice duration was significantly associated with MTSS status, $\chi^2(3) = 27.1756$, $p < .001$, Cramér's $V = .457$. MTSS was present in all players reporting practice durations exceeding 180 minutes, compared with 84.91% of those practising for 120–180 minutes, 45.45% for 60–120 minutes, and 50.00% for 60 minutes.

The number of rest breaks per training session was significantly associated with MTSS, $\chi^2(4) = 28.7834$, $p < .001$, Cramér's $V = .471$. Rest-break duration also showed evidence of association when evaluated using the prespecified exact procedure because of sparse expected cell counts, simulated Fisher exact $p = .031$, Cramér's $V = .245$.

Footwear type was significantly associated with MTSS status, $\chi^2(4) = 32.3667$, $p < .001$, Cramér's $V = .499$. MTSS was observed in 94.29% of players using hard-ground footwear and 86.67% of those using artificial-grass footwear, compared with 45.95% using firm-ground footwear, 52.17% using soft-ground footwear, and 20.00% using turf shoes.

Playing surface was significantly associated with MTSS based on the simulated Fisher exact test, $p < .001$, Cramér's $V = .378$. MTSS was present in 92.86% of players training on concrete or hard ground, 78.38% on artificial turf, 71.43% on mud or uneven ground, and 50.00% on natural grass.

DISCUSSION

The present study estimated the prevalence of medial tibial stress syndrome (MTSS) in intermediate-level male football players, described its clinical presentation and effect on training, and examined its relationship with training load expressed as the acute:chronic workload ratio (ACWR). Cases were identified with the shin palpation test[11] and graded with the MTSS Score[12]. MTSS was present in 89 of 130 players (68.46%; 95% CI 59.73–76.33), so it affected roughly two of every three players screened. Compared with unaffected players, those with MTSS were older, had more years of football experience, trained in longer sessions, reported higher perceived exertion, more often used hard footwear and surfaces, and showed a distinct workload pattern. Level of play and dominant leg were also associated with MTSS, whereas playing position was not.

This prevalence exceeds most published estimates, which range from about 14% to 20% in runners and reach 35% in military recruits[1,3]. It is, however, close to the highest figure on record, 69.5% in recreational marathon runners in India[26], and it suggests that football, with its repeated sprinting, landing and cutting, places a comparable burden on the tibia. Studies that report MTSS as a share of running injuries[2] or classify football injuries by tissue type and mechanism[6,7] describe a more modest proportion, but they depend on injuries that were reported, treated or that caused time away from play. We examined every eligible player regardless of whether care had been sought and counted mild symptoms accompanied by a positive palpation finding. Cortical microdamage can precede clinical symptoms[8,31], and young athletes commonly train through pain[14,16], so the detection of a previously hidden burden is more likely than a true conflict with earlier work. Exposure was also high, with a median of six training days a week and over half of the players practising for more than two hours per session, which exceeds that of the school-level players[10] and high-school runners[9,39] studied earlier.

Symptoms were mostly mild, with a median MTSS score of 3. Almost all affected players (98%) reported pain during sport, about three-quarters reported pain on walking, and just over half reported symptoms at rest, usually as tenderness rather than frank pain. This graded pattern matches the classic description of exercise-induced pain that eases with relative rest[3,12,17,31], and 53.93% of affected players still completed all their usual sporting activities, as expected at an early stage on the continuum towards tibial stress fracture[8,26]. Low scores should not be equated with low tissue stress, however, since MRI changes can coexist with modest symptoms[13] and periosteal oedema occurs even in athletes without MTSS[31].

A positive palpation test was more frequent on the right (55.38%) than on the left (39.23%), and bilateral involvement accounted for 38.2% of affected players, which favours a load-related rather than a traumatic origin. As three-quarters of the sample were right-leg dominant, greater loading of the dominant limb may partly explain the right-sided predominance. Left-dominant players, however, had a higher proportion affected (87.88% versus 61.86%), which this explanation does not accommodate, and because only 33 players were left-dominant this finding should be treated cautiously. Differences in leg muscle structure and neuromuscular recruitment have been described[4], whereas biomechanical variables in general relate inconsistently to running injuries[33] and tibial loading is emphasised in tibial stress fracture[5]. We therefore regard the laterality findings as exploratory.

Training was affected in 46.07% of affected players, mostly through a reduction in usual sporting activity (39.33%), while 6.74% could perform only alternative activities. The remaining players carried on unchanged and may be the group at greatest risk, since cortical microdamage accumulates when loading exceeds the capacity of bone to repair[8], ignoring early pain in young athletes leads to overuse injury, overtraining and burnout[14], and unrecognised MTSS may progress to stress fracture[3,30]. Early identification therefore matters, as targeted physiotherapy has reduced pain and improved performance in athletes with shin splints[18], and small changes in running speed, cadence or foot strike can lower tibial load[32].

The workload findings were the most informative. Affected players had higher coupled (median 1.19 versus 0.99) and uncoupled (1.26 versus 0.99) ACWR values, driven by a markedly higher load in the most recent week (median 3370 versus 2680). Their loads in the three preceding weeks, and their uncoupled chronic load, were modestly lower, by roughly 3–5%, than those of unaffected players, whose load stayed steady. MTSS was therefore associated not with high load as such but with a steep late rise from a slightly lower base. This agrees with evidence that workload spikes increase injury likelihood while a high chronic workload is protective[28], and with the link between ACWR and injury in professional soccer[29]. It also fits bone physiology: remodelling first

weakens the cortex through osteoclastic activity before periosteal reinforcement follows, so abrupt increases in load can outpace repair[8,16], and sudden progression of training is a recognised aetiological factor for MTSS[1,3,15]. Unlike many risk factors that have not helped clinicians prevent or treat MTSS[31], ACWR is modifiable and easy to monitor, which gives it practical value.

The coupled and uncoupled chronic loads moved in opposite directions, which is the expected result of mathematical coupling. In the coupled method the acute week forms part of the chronic average, so a high acute load inflates it (2823 in affected versus 2757 in unaffected players), whereas the uncoupled method uses only the preceding weeks and was lower in affected players (2628 versus 2728)[37,38]. Both ratios pointed the same way, and the uncoupled ratio, which compares the acute week with genuinely earlier loading, is easier to interpret. Causation may also run in reverse, because players in pain often reduce their training and lower earlier loads could therefore be a consequence of symptoms, a recognised problem in non-prospective designs[4]. Exponentially weighted averages may also be more sensitive to injury likelihood than the rolling averages used here[27]. Perceived exertion showed the largest group difference (median 6 versus 3) but probably reflects pain and fatigue as well as contributing to them. Training days per week were identical (median six), so session duration and intensity, rather than frequency, distinguished the groups, which supports a multidimensional view of overuse injury[1]. Cumulative exposure was another consistent theme. The proportion affected rose with football experience (36% with 2–3 years to 80% beyond four years) and with session length (85% for 2–3-hour sessions and all players practising beyond three hours), and affected players were older. Age and training load interact as risk factors for bone stress injury in soccer players[30], and earlier work identified years of running experience and previous MTSS as the strongest contributors to MTSS status[34]. A scoping review summarised studies in which greater athletic experience lowered later risk[26], which our results do not support; because age, experience and level of play are probably interrelated and were not analysed jointly, experience more likely marks accumulated exposure than adaptation. MTSS was most common in district (91.23%) and university (77.78%) players and least common in college players (37.84%), so the association with level of play was not a simple hierarchy and may reflect differences in training exposure, in parallel with the higher share of overuse injuries reported in professional than in amateur footballers[6,7]. Previous MTSS was not recorded.

Within sessions, more rest breaks (26% with one break, rising to every player with more than four) and shorter breaks (76% with 2–4 minutes versus 50% with 4–6 minutes) were associated with MTSS. This is counterintuitive but probably reflects longer sessions needing more breaks, and brief pauses giving the tibia little time to unload; we did not test this directly. Playing position showed no association, suggesting that the repetitive impact of sprinting, jumping and cutting is shared across positions and that bone stress risk is multifactorial rather than role-specific[30]. MTSS was far more common among players using hard-ground (94.29%) or artificial-grass (86.67%) footwear than firm-ground (45.95%) or soft-ground (52.17%) boots, and among those playing on concrete or hard ground (92.86%) or artificial turf (78.38%) than on natural grass (50.00%). Footwear acts as a biomechanical interface between player and ground, with outsole and stud design modulating load distribution[23], and boots should be matched to both player and surface[35]. Many players, however, lack awareness of suitable footwear and use studs unsuited to their surface[36]. The surface findings agree with studies reporting higher injury rates or altered injury patterns on artificial turf[19,20,22,25], although the evidence is not uniform, as the association of turf with ACL injury was not significant in every sport[21], and most of this work concerns traumatic rather than overuse injury. MTSS has also been reported to occur irrespective of surface or shoe type[31], and half of our natural-grass players were affected, so harder footwear and surfaces appear to add to risk rather than solely cause it. Footwear and surface are closely linked here, because players on hard ground tend to wear hard-ground boots, so their separate effects cannot be isolated, and only five players wore turf shoes. Several limitations should be considered. The cross-sectional design cannot establish whether workload spikes preceded MTSS or reduced earlier loading followed symptoms. Training load and exposure data were self-reported and open to recall error, and MTSS was identified clinically without MRI confirmation. Associations were examined individually without adjustment, so confounding among footwear, surface, level of play and exposure is likely. The sample was drawn from a limited number of teams and venues, which restricts generalisability, and some subgroups (left-dominant, turf-shoe users, goalkeepers) were small. In conclusion, MTSS was highly prevalent in intermediate-level male football players, was usually mild to moderate, yet limited training in nearly half of those affected. It was associated with cumulative training exposure, an abrupt rise in workload against a slightly lower chronic base, and hard footwear and playing surfaces. These findings support routine screening, ACWR-based monitoring with gradual load progression, and attention to footwear and surface, and they warrant prospective studies with adjusted analyses.

CONCLUSION

In conclusion, medial tibial stress syndrome (MTSS) was highly prevalent among intermediate-level male football players aged 18 to 22 years, affecting roughly two in every three of those screened. This is well above the figures usually reported for runners and military personnel. Most players had mild to moderate symptoms, with pain arising mainly during sport and far less on walking or at rest. Even so, training was disrupted in nearly half of those affected, and many others kept playing through the pain, which puts them at risk of progressing to a tibial stress fracture. MTSS was associated with older age, longer football experience, longer practice sessions and higher perceived exertion, which points to cumulative training exposure as an important factor. It was also associated with a recent sharp rise in workload relative to earlier training, reflected in a higher acute:chronic workload ratio. This fits the view that bone stress injury develops when load increases faster than the tibia can adapt. Players using hard-ground or artificial-grass footwear, and those training on concrete or artificial turf, made up a larger share of the affected group. Playing position and the number of training days per week did not clearly separate affected from unaffected players. Level of play was also associated with MTSS, although the pattern was uneven, with the highest proportions in district- and university-level players. These findings help fill a gap in a literature that has concentrated on runners and military recruits. They suggest that MTSS is a common but under-recognised problem in football, and one that players themselves are probably under-reporting. We therefore recommend routine screening with the shin palpation test and the MTSS Score, gradual weekly load progression with monitoring of workload ratios, matching footwear to the playing surface, and educating players, coaches and support staff to report early symptoms. Because the study was cross-sectional, these associations should not be read as causes. Prospective, multi-season studies with adjusted analyses, wider age groups and female players are needed to identify the independent predictors of MTSS and to test preventive strategies.

CLINICAL IMPLICATIONS

The high prevalence found in this study means that physiotherapists and sports medicine teams should regard shin pain in football players as a common problem, not an occasional complaint. Many affected players were still training normally, so symptoms alone are an unreliable warning sign, and teams should screen actively rather than wait for players to report pain. The shin palpation test and the MTSS Score are quick, inexpensive and easy to use on the field, which makes them suitable for both pre-season and in-season screening. Screening could be prioritised for older players, those with more years of football experience, players at higher competitive levels and those who practise for long sessions. Identifying MTSS early allows training load to be adjusted before it progresses to a tibial stress fracture and a long spell away from the game.

The link with a recent sharp rise in workload suggests that coaches and physiotherapists should avoid sudden jumps in weekly training load. Tracking perceived exertion and the acute:chronic workload ratio is a simple, practical way to pick up these spikes early, and the uncoupled ratio is easier to interpret when the acute week is compared with earlier training. Load should be built up gradually, especially after a break or when match fixtures are added to an existing training schedule. Footwear and playing surface are easily modifiable, so players should be advised to wear boots suited to the surface they play on, to limit training on concrete or hard ground where possible, and to use surfaces with better shock absorption when they can. Planned recovery, including adequate rest breaks, warm-up, cool-down and activation drills, should be built into team routines to support recovery and reduce repetitive tibial loading.

Players who already have symptoms may benefit from load management, running technique changes such as a lower speed or higher cadence, and conservative physiotherapy, including strengthening and stretching of the lower leg muscles. Educating players, coaches and support staff about reporting symptoms early, and about the risk of playing through pain, is essential, and it may ease players' worry about losing their place in the team. Overall, the findings support a team-based preventive approach in which physiotherapists, coaches and players work together on screening, load monitoring and equipment choices to keep players on the pitch.

LIMITATIONS OF THE STUDY

Despite promising results, certain limitations must be acknowledged.

Players may under reported shin pain due to fear of losing their place in the team, especially at the start of the season.

Early MTSS pain appears during sport and settles with rest, so players often treat it as a normal part of training.

Players have limited awareness about shin pain and do not realise that ignored shin pain can progress to a tibial stress fracture.

Shoe type and surface type were different and many players do not know the importance for wearing the correct shoe designated for a specific pitch type.

Warm-up and cool-down as well as activation drills were not performed by most players.

Teams did no post-match analysis, so there is no record of match demands or players complaints/ pain afterwards.

Female players were not included because they were either younger (12-16 years) or professional players which did not fit in the inclusion criteria. Therefore they were less in number and scarce which would not have resulted in homogenous population, so the findings apply only to males aged 18-22.

FUTURE SCOPE

Prospective design: Follow players over several seasons to establish whether workload changes or symptoms came first.

Adjusted analyses: Use multivariable models to identify the independent predictors of MTSS, since footwear, surface, level of play and exposure overlap.

Larger, multi-centre samples: Recruit from more teams and venues to improve generalisability.

Wider population: Include female and younger players in age-matched designs to show how risk differs by sex and stage of growth.

Imaging confirmation: Use MRI to separate MTSS from early tibial stress fracture.

Better load measurement: Use GPS monitoring and exponentially weighted workload ratios instead of self-reported training load.

Additional variables: Record match frequency, previous MTSS, body mass index, foot posture, footwear fit, and warm-up and cool-down practices.

Intervention studies: Test whether load management, footwear and surface changes, gait retraining and player education actually reduce MTSS in football.

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